PLAN OF ACTION (POA) FOR INVESTIGATION OF ETHYLENE GLYCOL SPILL AREA BETWEEN BUILDINGS 41 AND 43 NAVAL AIR PROPULSION CENTER TRENTON, NEW JERSEY

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1.0 INTRODUCTION

This Plan of Action (POA) report was prepared by IT Corporation (IT) at the request of the Department of the Navy, Northern Division, Naval Facilities Engineering Command, Philadelphia, Pennsylvania. This POA was prepared to address a recent ethylene glycol (EG) spill that occurred just south of Site 4, which is identified as the Building 41 Overhead Fuel Lines Leakage Area, at the Naval Air Propulsion Center (NAPC) in Trenton, New Jersey.

The objectives of this POA are to delineate the extent of any EG contamination, determine if remediation of soils and/or ground water is necessary, develop a list of remedial alternatives, and develop selected remedial actions.

The scope of the investigation will be conducted in two phases. Phase I will include a soil and ground water sampling program, monitor well installation, and geotechnical soil testing. Phase II will consist of aquifer testing (slug tests) of two monitor wells and soil sampling for bioassessment purposes. Phase II activities will be conducted based on the results of Phase I sampling.

The POA was prepared based upon the review of data obtained through previous investigations conducted at the site, interviews with NAPC personnel and site inspections conducted by IT personnel. In addition to the work plan, included in the POA are a Health and Safety Plan, and a project completion schedule.

1.1 SITE INVESTIGATION HISTORY

The first site investigative activities were conducted in 1985 in accordance with Phase I of the Navy Assessment and Control of Installation Pollutants (NACIP) program. Phase I consisted of an Initial Assessment Study (IAS) which was designed to identify areas of potential environmental concern caused by past hazardous substance storage, handling or disposal practices at the NAPC. Seven areas were identified as a result of this study, and were described in the IAS report prepared by Rogers, Golden and Halpern, May 1986.

Phase II of the NACIP consists of a confirmation study, the objectives of which are to verify the presence or absence of contamination, and to identify the potential contaminant migration pathways. The Confirmation Study was conducted by IT at the facility from October 1988 to April 1989. During this study, the seven sites of potential environmental concern identified in the IAS were investigated, as well as two additional areas identified by the New Jersey Department of Environmental Protection (NJDEP). The results of these investigations were submitted to the Navy in the "Report on Soil and Ground Water Extent of Contamination Investigations," August 1989.

Site 4, the Overhead Fuel Lines Leakage Area, is the area just north of where the EG spill occurred. The results of soil samples collected from Site 4 as part of the Confirmation Study which were analyzed for volatile organic compounds (VOCs), indicated the presence of acetone, ethylbenzene, toluene, xylenes, and trichloroethylene in two of the three borings (SB-17 and SB-18) completed in this area. The total VOC levels were both below the NJDEP/ECRA cleanup criteria of 1 part per million (ppm) for soil. There were no additional compound groups analyzed. The only ground water sample (MW-15-S) analyzed from this site contained total VOC levels of 281 and 287 parts per billion (ppb) for two rounds of sampling. Both values exceeded the ECRA 50 ppb criteria for total VOCs in ground water.

1.2 SPILL DESCRIPTION

A release of approximately 3,000-gallons of a 50/50 mixture of EG and water occurred on the ground surface between Buildings 41 and 43 at NAPC Trenton on February 1, 1989. The glycol mixture is used to cool exhaust produced from the testing of jet engines. The source of the spill was from a 4700 gallon storage tank and occurred during night-time filling operations. The spill was discovered the following morning by NAPC personnel. In response, NAPC personnel pumped the EG which was pooled around the tank area into drums. The product recovered by pumping was estimated to be 100-gallons. The remainder of the spill soaked into the soil except for approximately 100-gallons which entered the NAPC storm sewers via the two catch basins located on the east side of the tank. The area covered by the spill was approximately 50 by 60 feet in size and is shown as the outlined area on Figure 1. Site personnel performed test trench activities which included ground water sampling outside the spill area to assess the immediate impact on the soils and ground water. The details of this investigation are presented in Section 3.0.

2.0 GEOLOGIC SETTING

2.1 REGIONAL GEOLOGY

The NAPC site is located within the Piedmont Lowlands physiographic province. The rocks comprising the Piedmont Lowlands are collectively known as the Triassic-Newark Group and are 190-230 million years of age (mya) and are composed of interbedded sandstone, siltstone, shales, and conglomerates. Resistant argillites and volcanic rock in the form of both lava flows and intrusive sills and dikes also exist within the province. These rocks lie in a southeast-northwest trending belt and are regionally tilted to the northwest.

The soils in the vicinity of the NAPC Trenton site consist of alluvial deposits, cut and fill land, and rock substratum. Cut and fill land consists of materials that have been mixed by excavation, filling, or other disturbances such that the original soil horizons have been destroyed. In areas where the original soil has been excavated to bedrock and replaced with fill, the depth to bedrock generally ranges from 2 to 8 feet. The texture of fill materials ranges from sand to clay, and in some instances consists mostly of stone.

The alluvial deposits, designated as the Pennsauken Formation, overlie the Triassic rocks and are a discontinuous mantle of alluvium deposited during the Quaternary period. The alluvium is assorted material composed mainly of silt with minor amounts of intermixed sand and gravel and ranges in color from orange-brown to dark brown. The silty soil in some areas overlies coarser stratified material consisting of intermixed sand and gravel.

2.2 SITE GEOLOGY

2.2.1 Site Overburden Geology

Based on borings performed on site during previous investigations (IT, August, 1989) the NAPC site is generally underlain by Pleistocene surficial glacial deposits consisting of silty sand, clay, and gravel. Thicknesses range from a minimum of four feet below grade along ridges to a maximum of approximately 30 feet in the northern areas, with an average depth to bedrock of approximately 17 feet. These soils were deposited primarily by rivers and streams during warm periods between stages of glaciation. Fill material, up to 7 feet in thickness, overlies the interglacial deposits and generally consists of sand, clay, shale fragments, and cinders. These deposits have a poor to moderate permeability and thus are responsible for the relatively poor drainage of the area.

This most recent site investigation conducted by IT from October 1988 to April 1989, encompassed three general areas of the site. One area extends from just east of Building 42 and westward toward the West Drainage Ditch (see Figure 1). The second area is located north of the cooling towers and west of Building 34, and the third area is located in the eastern portion of the site adjacent to the aboveground tank farm and drum storage area.

Soils in the vicinity of Building's 41 and 42, which includes the study area addressed by the IT investigation, predominantly consist of stiff silty clay with trace amounts of sand and gravel. Lenses of dense silty sand were observed in a few borings. The silty clay grades into a silt with variable small amounts of clay, sand, and gravel, proceeding to the west. South of the silty clay, soils grade into a fine-to-coarse sand and a medium-to-fine gravel overlying bedrock. The thickness of the overburden in this area ranges from approximately 5 to 15 feet. In the immediate vicinity of the spill, the overburden ranges from 9.5 to 14 feet thick, based on borings SB-17 and 18 and MW-15-S, located between Buildings 41 and 43. The thinnest overburden deposits occur immediately north and east of Building 55 where a ridge of bedrock occurs below the surface.

2.2.2 Site Bedrock Geology

Based on the subsurface data to date, bedrock elevations in the central portion of the site range from approximately 160 feet to approximately 136 feet decreasing in the southerly and southeasterly directions. Steepest bedrock gradients occur in the easternmost section. A shallow depression is located beneath Buildings 41 and 42, where elevations dip to approximately 136 feet above mean sea level. Immediately south of the depression, a bedrock ridge juts from the west extending out as far as Building 22. The ridge elevation is approximately 144 feet. The bedrock surface encountered in most of the borings was found to be extensively weathered.

Ridges and slopes of the bedrock have an overall east-northeast trend which is broadly consistent with bedding planes that have been mapped from outcroppings in the vicinity of the site. The character of the bedrock topography, therefore, may reflect differential erosion of stratigraphic layers in the bedrock.

Two distinct geologic formations underlie the NAPC site. These are the Lockatong and Stockton Formations, both of Triassic age. The base of the Lockatong Formation is present in the site area. It consists of gray to black siltstones with the occurrence of argillite beds which are resistant, chemically cemented siltstone. Occasional zones of thinly-bedded black carbonaceous shale also are common. The Lockatong Formation is considered to be derived from lake deposits. Monitor wells and soil borings that were advanced to bedrock indicate that a dark gray to black mudstone, presumably the Lockatong Formation, underlies the northern and northwestern portions of the site. The Stockton sandstone Formation underlies the southern portion of the NAPC Trenton site (New Jersey Geological Survey, 1912), is stratigraphically the older unit, and consists of tan or red, coarse-to-medium grained sandstone derived from river channel deposits. The Stockton Formation was most likely encountered in the boring completed for the installation of the 603-foot production well adjacent to the tank farm (Widmer, 1965). The high yield of this well (120 gpm) suggest that it intercepts the Stockton Formation, as the Stockton is noted for its high yield compared to the Lockatong.

The Lockatong argillite has a poor capacity to transmit water due to its fine-grained nature. Voids and fractures near the bedrock surface are commonly filled by the weathered clay material of the argillite, inhibiting the flow of water between the overburden and the bedrock. Any water infiltrating the Lockatong will likely travel slowly. The Stockton Formation has a high capacity to transmit water because it is coarser-grained and is more brittle which allows for higher development of fracture permeability.

2.3 HYDROGEOLOGY

2.3.1 Surface Hydrology

There are no streams, creeks, or lakes located on the site. However, there are four streams that surround the site within a 1-mile radius. These include Gold Run, the western branch of Shabakunk Creek, and two unnamed creeks, all of which drain into the Delaware River. Only Gold Run, which is located southeast of the site, receives drainage from the NAPC site. Therefore, surface runoff from NAPC and surrounding areas eventually drains into the Delaware River.

The predominant direction of storm water drainage is north to south. Storm water draining from the site is intercepted by a 48-inch storm water sewer which runs beneath Parkway Avenue. The storm sewer line empties into Gold Run approximately ¼-mile from the site. In the western-most portion of the site, surface water drains into the west end drainage ditch and then enters the off-site storm sewer system which then empties into Gold Run.

2.3.2 Ground Water

Ground water flow at the site is divided into flow within the overburden deposits and the bedrock. The ground water investigations completed thus far were focused on identification of ground water quality and flow directions within the overburden. The investigation of the bedrock aquifer has been limited to a single bedrock piezometer (BRP-1).

The depth to the water table in the overburden ranges from 6 to 14 feet below ground surface, based on water level measurements taken from existing monitoring wells. The direction of ground water flow in the overburden is generally south-southeast as shown on Figure 2. In the vicinity of the spill the depth to ground water was measured at approximately 3 feet below ground surface in MW-15-S, located northwest of the spill. Ground water level measurements taken in April 1989 were used to prepare the ground water contour map presented as Figure 2. A comparison of this map to one constructed from measurements taken in January 1989 indicates that the configuration of the water table remained fairly consistent.

The water elevations did not fluctuate significantly (less than 1 foot) at Sites 1, 4, and 5, while at sites 6 and 9, one to three foot increases in elevation were observed in the April measurements. In the third area contoured, Site 3, ground water elevations exhibited 2 to 5 foot fluctuations. One factor which may contribute to the lack of variation in the ground water table at Sites 1, 4 and 5 is the presence of a relatively thin silty sand unit directly above the bedrock and adjacent to the silty clay unit. This may produce a confining situation, thereby inhibiting ground water flow into and out of this area, and creating a perched ground water zone. The building foundations also inhibit the flow of ground water and may contribute to the "perched" effect. The foundation of Building 41, which is adjacent to the spill area, may actually be seated in bedrock, and may cause the ground water high observed in this area, by restricting shallow ground water flow.

Ground water occurrence in the overburden at the NAPC site is not continuous, and ground water was not encountered at certain boring locations, which are shown as shaded areas on Figure 2. The extent of these 'dry' areas has not been precisely delineated at present. Their presence is most likely the result of a combination of variations in the permeability of the overburden deposits and fluctuations in the bedrock surface elevation. An example of a dry area is the zone located between Buildings 40 and 41. This area corresponds to the location of a bedrock ridge. This ridge rises above the shallow ground water table. Since the soil borings extended only to the bedrock surface, the ground water table was never encountered. The occurrence of this dry area has several important implications regarding potential contaminant migration routes. Shallow ground water flow encountering this 'dry' area is given the opportunity to enter the bedrock aquifer if a fracture presents less resistance to flow than the surrounding soil. Another possibility is that the bedrock island blocks ground water flow to the south, thus as ground water mounds behind the bedrock island, ground water is redirected around the bedrock knob. This redirection can enlarge the ground water contaminant plume.

The presence of building foundations also creates local variations in shallow ground water flow. An example is the mounding of the water table on the north side of Building 41. The flow of ground water in the area is blocked from moving south by Building 41's foundation which extends to bedrock. Ground water would be redirected to the east or west. Additionally, the ground water could be forced to flow down along the porous backfill next to the foundation walls thus eventually encountering bedrock. Therefore, the presence of building foundations could influence the extent of any contaminant plumes.

The bedrock aquifer of concern at the site is the Lockatong Formation which is located directly below the overburden. The Stockton Formation was encountered at a much greater depth (in the on-site production well) within the area investigated. The Lockatong formation is generally well fractured but the typical overall permeability is generally reduced by infilling of the fractures by degraded rock matrix. The bedrock aquifer is assumed to be under both semi-confined and unconfined conditions. It is estimated that semi-confined conditions exist in the shallow bedrock just south of the water cooling towers. The condition is created by the rapid drop in surface elevation and the low permeability of the overburden deposits. This condition is probably very local and it is estimated that the confining water pressure would dissipate rapidly moving southward. Flow within the bedrock is controlled by the fracture system and bedding planes and at present, it is not possible to determine flow direction or flow rates without further data (additional bedrock wells and pump test).

The interconnection between the overburden and bedrock aquifers has not been established at present, but it is estimated to be good due to the presence of 'dry' zones, backfill along foundation walls, and the actual thickness of the overburden aquifer (less than ten feet in most cases).

3.0 TEST TRENCH INVESTIGATION

3.1 DESCRIPTION OF TEST TRENCH ACTIVITIES

On February 9, 1989, NAPC performed three exploratory test trenches outside the spill boundary to assess the extent of migration visually and to obtain ground water samples. The location of the test trenches are shown on Figure 3. The first test trench was located at the southeast corner of Building 48 and was completed to a depth of seven feet below ground surface. During excavation of Test Trench No. 1, fractured bedrock was encountered throughout the entire depth of the trench. No ground water was present in the trench during the excavation, however, upon inspection the following day, ground water was present in the bottom of the trench. There were no visible signs of contamination in either the soil or the ground water in Test Trench No. 1. Two ground water samples were collected from this test trench prior to its closure on March 20, 1989. The analytical results for these samples and samples from the other two trenches are discussed below in Section 3.2 and are presented in Appendix A.

The second test trench was excavated north of the spill area and east of Building 43. Clay soils, some of which were notably green in color, were encountered throughout the depth of the trench, which was seven feet. Ground water was observed at a depth of four feet in Test Trench No. 2, and a slight oil sheen was observed on the surface of the water. Three rounds of ground water samples were collected from Test Trench No. 2 prior to backfilling.

Test Trench No. 3 was excavated west of the spill area and just east of monitoring well MW-15S (Figure 3). Sandy soils were encountered in this test trench from ground surface to a depth of approximately four feet where alternating layers of sand and clay were present throughout the total depth of the trench (seven feet). Ground water was observed seeping into the trench from the west side during excavation. Two ground water samples were obtained from Test Trench No. 3 prior to backfilling operations.

3.2 TEST TRENCH SAMPLING

Samples of the water that collected in the test trenches were obtained and analyzed for EG. The first round of samples were collected on February 10, 1989, one day after the excavation of the test trenches, and included samples #1-1, #2-1 and #3-1. Grab samples of the water were collected from each trench and only the sample from Test Trench No. 2 (#2-1) showed any visible signs of contamination, as an oil sheen was present on the surface of the water.

The water that collected in the trenches after the first round samples were taken was pumped out prior to the second round sampling in order to obtain representative ground water samples. Ground water recharge into the trenches was observed, and it was noted that ground water flowed readily back into Test Trenches 2 and 3, while Test Trench No. 1 recharged slowly. The second round of water samples was collected from the three trenches on February 17, 1989 (samples #1-2, #2-2, and #3-2). A third sample (#2-3) was collected from Test Trench No. 2 only, on February 28, because this trench was thought to be the location that would most likely be affected due to its proximity to the spill. Prior to sample collection the trench was evacuated of all standing water and allowed to recharge.

The samples were collected directly in appropriate laboratory glassware and delivered to Rancocas Environmental Laboratories, Inc. located in Delanco, New Jersey. The samples were analyzed for EG only. The sample results were less than 2 ppm for all samples except for sample #2-3, which was less than 5 ppm. The sample results are provided in Appendix A.

4.0 ETHYLENE GLYCOL RESEARCH

A literature search was conducted prior to the development of this POA to identify and locate published material concerning EG. The search was focused primarily on the location of technical information concerning the physical characteristics of EG and remediation techniques which have been implemented in the cleanup of EG contamination. The published material obtained was used to prepare this chapter, and the complete listing of literature references identified is presented in Appendix B.

4.1 INTRODUCTION

Ethylene glycol is a colorless, sweet tasting hygroscopic, practically odorless liquid. Its chemical formula is $HOCH_2CH_2OH$, its molecular weight is 62.08 and its specific gravity is 1.12 at 20°C. Generally glycols are used as heat exchangers, antifreeze formulations, hydraulic fluids, chemical intermediates, solvents, polishes, cosmetics, and detergents (Windholz, et al., 1983). The ready availability of antifreeze mixtures make EG intoxication a significant medical and veterinary problem.

The first reported case of human EG intoxication in the United States appeared in 1930 (Anonymous, 1930). Since then numerous cases have been reported in both the medical and veterinary literature. The incidence of EG intoxication in veterinary medicine is quite significant, for countless numbers of poisonings in dogs and cats occur annually. Many cases are not reported and many cases are not even diagnosed.

The reasons for EG intoxication include the warm, sweet taste and ready availability. EG is a popular agent for suicide and a "poor man's" substitute for alcohol. Many accidental ingestions occur since EG solutions are frequently stored in old liquor bottles. The warm, sweet taste also contributes to the pediatric risk.

4.1.1 Physical Characteristics

Due to their low volatility (vapor pressure of 0.05 mm Hg at 20°C/latent heat of vaporization - 4033 cal/g) glycols produce little vapor hazard at ambient temperature but can be encountered as vapors and mists due to application at elevated temperatures. EG is completely soluble in water at 20°C and miscible in ether, low aliphatic alcohols, aldehydes or ketones. EG is also rapidly absorbed by the body after ingestion.

4.1.2 Human Toxicity and Mutagenicity

Ethylene glycol has been documented to cause bladder stones, severe kidney damage and moderate liver damage in rats when administered chronically in the diet. Exposure through inhalation causes nausea, throat irritation and dizziness. In addition, musculoskeletal abnormalities and cranofacial defects were observed in the off-spring of pregnant rats that were given high doses of EG orally. Carcinogenicity studies on mice indicated no evidence of oncogenic effects from EG exposure.

The single oral lethal dose of EG for a human has been established at 1.4 mg/kg or about 100 ml (3.38 ounces) for an adult weighing 70 kilograms or 154 pounds (Rowe, 1963). This estimate indicates that EG is more acutely toxic for humans than for animal species for which LD_{50} ranges have been determined. The USEPA (1987) has established criteria on the chronic reference dose (RfD), formerly called the Acceptable Daily Intake (ADI) which is an estimate of a daily exposure to the human population that is likely to be without appreciable risk of deleterious effects over a lifetime. The RfD has been set at 1.0 mg per kilogram per day (1.0 mg/kg/d). The American Conference of Governmental Industrial Hygienists (ACGIH) has promulgated criteria on the acceptable exposure to EG based on an 8-hour work day (40-hour work week). This criteria is termed the Threshold Limiting Value (TLV) or ceiling limit which is 125 mg/m^3 (50 ppm) for EG. This value is the allowable maximum exposure level at which minimal irritation to nasal membranes will occur.

The Food and Drug Administration is aware of one report (Rappaport, 1948) which suggests that EG at high concentrations may cause mutations in Drosophilia. To the FDA's knowledge, this has not been confirmed (Federal Register, 1978). Using a bacterial plate assay, Embree (unpublished) tested EG on S. typhimurium strains TA 1535, TA 1537, and TA 1538 without microsomal activation and found no reversents.

4.1.3 Transport and Fate

Information on the transport and fate of EG is limited, and suggests that due to its low vapor pressure it is unlikely to volatilize. Releases to surface water and soil are biodegraded rapidly, largely due to oxidation. In ground water, EG is completely miscible and therefore moves freely. Based upon its physical properties, EG is not expected to bioaccumulate.

4.2 REGULATORY GUIDELINES

Currently there are no cleanup levels or standards established by either the NJDEP or the USEPA for EG in soils, surface water and ground water. All NJDEP divisions contacted, including ECRA, the Division of Water Resources, Division of Waste Management, Bureau of Safe Drinking Water and the Bureau of Environmental Evaluation and Risk Assessment reported that cleanup levels are decided on a case-by-case basis and would require the preparation of a site-specific risk assessment. The USEPA Office of Drinking Water (ODW) Health Advisory (HA) Program has generated the only published criteria for EG in drinking water. These criteria are nonregulatory concentrations of drinking water contaminants at which adverse health effects would not be anticipated to occur over specific exposure periods. Health Advisories serve as informal technical guidance to assist federal, state and local officials in the protection of public health in instances when emergency spills or contamination occur. As such, the HAs are not enforceable federal standards. The health advisories available are as follows:

ODW HEALTH ADVISORIES (MG/L)[1]

	EXPOSURE PERIOD		
	1-day	Longer-Term[2]	Lifetime
child	19.0	5.5	--
adult	66.0	19.3	7.0

(1) Based on a body weight of 70 kg (154 pounds) and daily water consumption rate of 2 liters/day for an adult, and a weight of 10 kg (22 pounds) and consumption rate of 1 liter/day for a child.

(2) Considered to be adequately protective over a ten-day exposure period.

Ethylene glycol is not listed on either the USEPA Priority Pollutant List or the Hazardous Substance List, nor is it a regulated chemical in the State of New Jersey. This is partially due to its widespread usage as a coolant in automobiles. Therefore, information regarding completed cleanups of EG and suggested cleanup levels is not readily available, as cleanup of this substance is not enforced.

4.3 REMEDIATION TECHNIQUES FOR ETHYLENE GLYCOL CONTAMINATION IN SOILS AND GROUND WATER

There is little information on the presence of EG in air, soil and water, and therefore, remedial techniques for EG are also not well-documented. Because of its rapid degradation in the environment, EG is not expected to be a persistent contaminant in air, soil or surface water. However, contamination of ground water is more likely. Due to its high solubility in water and low vapor pressure, EG contamination in ground water could not be effectively removed by aeration. Ground water treatment with activated carbon would not remove much EG either because of its low adsorbability, which is 0.0136 mg/g carbon with only 6.8 percent EG retention (Verschueren, 1977). Remedial techniques which may be appropriate for this site are presented below.

4.3.1 Bioremediation

Bacterial degradation of EG in soil, water, and sewage systems is well-documented for both aerobic and anaerobic systems. Laboratory researchers have reported contaminant half-lives of seven days and less for a 1,000 ppm spike of EG under simulated soil conditions (Union Carbide, 1985). One pilot study remediating contaminated ground water was reported to have biologically removed EG below detection limits in 26 days (Flathman, et al., 1989). The initial EG concentration varied between 1100 ppm and 3400 ppm in the ground water. The water was pH-adjusted and then treated in a surface bioreactor supplemented with nitrogen, phosphorus and oxygen.

Biodegradation of EG can be stimulated by providing the essential nutrients and oxygen to the indigenous bacterial population within the proper pH range. The Trenton NAPC site is unique in that the EG lies in soils that may be unsaturated and which are located in a highly congested area. A land treatment system can be designed to compensate for these characteristics and to maximize the potential bioremediation rate. The biodegradation rate in soils is often limited by oxygen transport and contaminant availability as well as ambient temperature, hence the rate may be slower than that described for water remediation.

To successfully implement bioremediation at the NAPC site, a characterization of the site with regard to the concentration and area of contamination (including depth of contamination), soil characteristics, and extent of Navy activity in the vicinity of the target area must be documented. In addition, a feasibility study must be performed to determine the applicability of bioremediation to this specific area. The feasibility study will require 5 soil samples from the target area, and includes the following tests:

- Enumeration of the heterotrophic and EG - degrading bacterial populations
- Nitrogen and phosphorus analysis
- pH analysis
- Microbial stimulation test with nutrient augmentation

This sampling will be conducted pending the evaluation of the analytical results from soil samples collected during Phase I. If the results indicate that significant EG contamination is present, the bioassessment samples will be collected and the feasibilty study performed as part of Phase II investigative activities. The tests listed above are recommended based on IT's previous experience with land treatment of soils contaminated with organic materials. The results indicate whether biodegradation of the contaminants can be stimulated using the indigenous organisms, and the test results are used to determine the final design and cost estimates for complete bioremediation.

Upon completion of the above described tests, a full report with recommendations for implementation will be submitted. Upon acceptance of the report, the IT Biotechnology Center located in Knoxville, Tennessee, will work with Edison personnel to implement bioremediation at the NAPC site.

4.3.2 Soil Flushing

An alternative approach to surface land treatment would be soil flushing. This would involve flushing the vadose zone with water and recovering the ground water for treatment. This process would utilize the solubility of EG in water to remove it from the subsurface soils.

4.3.3 Chemical Peroxidation

Chemical peroxidation is a process that could be developed by IT once the suitability of the site conditions for this technique is established. This technique would be used for removal of EG from the ground water. The contaminated ground water would be pumped into a mixing tank or batch reactor to which a dilute hydrogen peroxide solution would be added. In the mixing tank the peroxide solution would oxidize the EG and thereby remove it from the ground water. This method would involve meticulous monitoring of the peroxide solution concentration because of its potential reactivity with EG.

An alternative in situ remediation approach would involve sprinkling the peroxide solution onto the ground surface. The peroxide solution would percolate through the saturated zone and oxidize the EG present. In order to determine the suitability of the spill area for this technique, the peroxide stability in the soil would have to be determined, as well as the reaction rate for peroxide and EG.

5.0 FIELD INVESTIGATION

The field investigation has been divided into two phases. Phase I is designed to establish if ethylene glycol contamination exists in the soil and ground water as a result of the spill. Phase I will include monitor well installation, soil and ground water sampling and geotechnical sample collection and analysis. If the analytical results for Phase I samples indicate the presence of contamination at levels which may require remediation, Phase II of the investigation will be performed. Phase II includes aquifer testing and collection and analysis of soil samples to determine the suitability for bioremediation.

5.1 PHASE I

5.1.1 Subsurface Soil Sampling

A subsurface soil investigation will be conducted at the EG spill area for the purpose of delineating potential soil contamination resulting from the spill. Previous sampling just west of the spill site has identified volatile organics in the soil, which include acetone, ethylbenzene, toluene, xylenes and trichloroethylene (TCE). Ground water sampling indicated the presence of these same volatile compounds in addition to 1,2-dichloroethene. The objective of this investigation is to delineate the lateral and vertical extent of any soil contamination and to determine the impact on site ground water attributed to the EG spill.

5.1.1.1 Chemical Sampling

A minimum of nine hand auger borings will be performed at the locations shown on Figure 3. More soil boring locations may be added in the field based on the presence of visible signs of contamination, and will be selected at the discretion of the on-site hydrogeologist. All samples collected from the borings will be analyzed for EG. In addition, the soil sample from B-28 will be analyzed for priority pollutant metals. This information will assist in determining the suitability of the soils for bioremediation, because specific concentrations of certain metals can be toxic to contaminant-degrading bacteria. Therefore, the metals content can be a limiting factor in the bioremediation process.

Since the spill area is congested due to the presence of overhead piping, underground utilities, aboveground storage tanks and buildings, the use of a drill rig is prohibited. Therefore, the soil samples will be obtained with stainless steel hand augers. The samples will be collected above the water table which was measured at a depth of three feet below ground in MW-15S (northwest of the spill area). Based on the depth to ground water, one soil sample will be collected from a depth of two to three feet or from the one-foot interval just above the water table in each boring. In the event that ground water is not encountered, soil samples will be collected at five-foot intervals to bedrock, which is at a depth of approximately 10 to 14 feet in this area. Collection of samples below a depth of three to four feet would require the use of a small portable tripod drilling apparatus. Such equipment can be easily assembled within the study area, if necessary.

5.1.1.2 Geotechnical Sampling

Soil samples of the overburden will be obtained for grain size and permeability analysis. This information is necessary in order to plan future work at the site such as pump tests and remedial design which may include installation of recovery wells. Two grain size samples will be collected within the spill area from hand auger borings SB-27 and SB-32. Sampling at these two locations will ensure adequate coverage of the spill zone. The samples will be collected in the unsaturated zone at depths to be determined in the field by the on-site hydrogeologist. The grain size analyses will be used to assist in determining the permeability of the overburden soils.

In addition to the grain size samples, one Shelby tube sample will be attempted in MW-2-BR. A cohesive soil layer such as clay is necessary in order to obtain such a sample. If a clay layer is encountered, a Shelby tube will be pushed into the clay for a sample. The Shelby tube will be sealed at both ends with wax immediately upon extraction from the boring in order to retain undisturbed sample characteristics. This sample will then be shipped to a geotechnical laboratory for permeability analysis.

5.1.2 Monitor Well Installation

In order to assess the potential impact of the EG spill on site ground water, two (2) monitoring wells will be installed. The locations of the wells are shown on Figure 3, as MW-27-S, a shallow overburden well, and MW-2-BR, a bedrock well. The locations of the wells were selected based on the known direction of ground water flow in the overburden aquifer which is southeast (Figure 2). Additionally, the foundation of Building 41 may channel shallow ground water flow along it in this direction. The direction of flow in the bedrock has not yet been established at the site, however, the proposed bedrock well location was selected based on the proximity to the spill area and because the direction of bedrock ground water flow is often similar to overburden flow. Additionally, if the EG was transported in the overburden ground water, it would most likely enter the bedrock in this direction.

The shallow well, MW-27-S will be completed just above the surface of the bedrock and the boring will be continuously sampled to bedrock to obtain lithologic information. In addition, one soil sample will be collected in MW-27-S from the two-foot interval immediately above the water table, and will be analyzed for EG, to determine the lateral extent of soils contamination. One shelby tube sample will also be obtained from the boring for the installation of MW-2-BR, for permeability testing, providing clay soils are encountered as described in Section 5.1.2. The monitor well installation methodology and construction specifications are presented in Section 6.2.

5.1.3 Ground Water Sampling

In order to assess the potential impact of the EG spill on ground water, three existing monitoring wells as well as the two proposed wells will be sampled. Monitor wells which will be sampled include overburden wells MW-15-S, MW-17-S, and MW-27-S, and bedrock wells BRP-1 and MW-2-BR which are in the vicinity of the spill area. These wells were selected for sampling based on their proximity to the spill area and the established direction of ground water flow in the overburden. Although the direction of flow in the bedrock has not been documented at the site, it is assumed to be similar to the overburden. All of the above wells will be sampled and analyzed for EG, and in addition, MW-15-S will be analyzed for priority pollutant metals. Well MW-15-S will be analyzed for metals because information on the metals content in ground water is necessary if bioremediation is considered later. The bacteria utilized to degrade contaminants are often sensitive to certain metals, and thus can limit the effectiveness of this technique. The sampling and analytical protocol are described in Section 6.3.

5.1.4 Ground Water Contour Map

After the wells have been installed and developed, a licensed New Jersey surveyor will locate the wells on a base map and survey the elevations of the tops of the well casings and ground surface to the nearest 0.01 foot. The wells will be initially sampled two weeks after they have been installed and developed. Prior to purging the wells, water level measurements will be taken with electronic water-sensitive probes. Water elevation measurements in the monitor wells will be recorded to the nearest 0.01 foot. These measurements will be used in conjunction with the surveyor's well casing elevations to calculate ground water elevations at each well. A ground water contour map will then be developed from this data.

5.2 PHASE II

This phase includes slug testing of two shallow monitor wells to obtain information about the overburden deposits necessary for future design of pump tests and recovery wells. Collection of soil samples for biodegradation analyses will also be performed in order to determine the feasibility of implementing bioremediation of the soil and/or ground water.

5.2.1 Aquifer Testing

In order to determine the average hydraulic conductivity and transmissibility of the overburden aquifer, a borehole permeability test (slug test) will be performed on MW-15-S and the proposed overburden well, MW-27-S. A slug consists of a 10-foot length of PVC pipe filled with water and sealed at the ends. This data is necessary for the design of remediation systems involving flushing of soils and recovery and treatment of ground water.

Initially, the static water level in each well will be measured and recorded using an electronic water level indicator. A pressure transducer connected to a data recorder will then be submerged in the well. Afterward, the PVC slug will be rapidly lowered into each well displacing a known volume of water. The initial water level deflection and subsequent fall of the water column will be recorded continuously on a strip chart recorder. This procedure will then be repeated in reverse as the slug is rapidly removed from the well. Slugs will be decontaminated between uses by the procedures outlined in Section 6.4.

The data from both the falling and rising head tests at the two overburden well locations will then be analyzed to determine the hydraulic conductivity and transmissibility of the overburden aquifer.

5.2.2 Biodegradation Sampling

Six soil samples will be collected from the spill area at five locations (BS-1 through BS-5), and will be analyzed for parameters which will indicate the suitability of the area for bioremediation. Five of the samples will be collected from the saturated zone at each location. One sample will also be collected just above the water table or in the capillary fringe zone at one of the five sampling locations. This sample will provide a "worst-case" example of contamination. If EG is present in the ground water, it would be continually deposited in the soils at this depth as the ground water surface fluctuates.

The following tests will be conducted on the soil samples:

- Enumeration of heterotrophic and EG - degrading bacteria
- Nitrogen and phosphorous analysis - to determine existing levels in the soil in order to calculate if additional nutrients need to be added.

- pH analysis - to determine existing conditions, as this is a critical factor in maintaining biodegradation reactions.
- Microbial stimulation test with nutrient augmentation - to determine the response of bacteria in the soils to the addition of nutrients.

The sample analysis and evaluation will be performed by the IT Biotechnology Center in Knoxville, Tennessee.

6.0 FIELD SAMPLING PROTOCOL

6.1 SOIL SAMPLING AND ANALYSIS

Soil samples located in the spill area (SB-26 through 34) will be collected with stainless steel hand augers up to a depth of four feet. Below this depth, a gasoline-powered tripod drilling apparatus will be utilized to drive two-foot, carbon steel split-spoon samplers. The split-spoon samplers will be driven by a 140-pound hammer with an average fall of 30 inches to the described sampling depth. Each soil sample will be logged and collected for laboratory analysis as well as screened for non-methane volatile organics with an organic vapor analyzer (OVA) or HNU. Samples will be removed from the sampling equipment with stainless steel instruments and placed on Saranex-coated laboratory benchkote pads. Samples will be handled in the field with latex surgical gloves which will be discarded with the benchkote pads between samples. All sampling equipment will be decontaminated between each use to prevent cross-contamination of samples (see Section 6.4).

Samples will be placed into appropriate laboratory glassware cleaned according to USEPA protocol and supplied by I-Chem Research. The samples will then be stored in a sample shuttle and kept cool until delivery to the IT Analytical Services Laboratory located in Monroeville, Pennsylvania. All samples will be analyzed for EG according to the methodology presented in Appendix D. Six samples for bioassessment purposes may also be collected from the spill area during Phase II of the investigation and will be analyzed by the IT Biotechnology Center in Knoxville, Tennessee for the parameters listed in Section 4.3.1.

Field and trip blanks will be submitted with soil samples for quality assurance purposes. The field blank will consist of two sets of laboratory-cleaned sample containers. One set of containers will be empty and the other set will be used for the samples to be analyzed. The second set of containers will be filled at the laboratory with laboratory-demonstrated analyte-free water. At the field location believed to be most contaminated, the analyte-free water will be passed through field-decontaminated sampling equipment (see section 6.4 for decontamination protocol) and placed in the empty set of containers. This water will be analyzed for the same parameters as samples collected that day in order to verify the decontamination procedures.

The reason for performing field blanks in the most contaminated area is to attempt to simulate a worst-case scenario regarding ambient air contributions to sample contamination. Field blanks will be performed at a rate of one per day per sample matrix regardless of whether samples will be shipped that day.

The trip blank will consist of a set of sample containers filled at the laboratory with laboratory-demonstrated analyte-free water, and will be analyzed for volatile organics including EG. Trip blanks will be handled, transported, and analyzed in the same manner as the samples acquired that day, except that the sample containers themselves will not be opened in the field. Trip blanks will accompany samples at a rate of one per shipment or two-day sampling event. Individual sample matrices and associated blanks will be packaged in separate sample shuttles prior to shipment to the lab. Trip blanks will be returned to the lab with the same set of bottles they accompany to the field.

6.2 MONITOR WELL INSTALLATION

The soil borings for monitor well installation will be performed utilizing a rotary drilling rig equipped with hollow stem augers. Augers with 6¼-inch inner diameter will be used for monitor well installation. Continuous soil samples will be obtained in boring MW-27-S utilizing a 2-inch outer diameter carbon steel split spoon, driven by a 140-pound hammer with an average fall of 30-inches. The samples will be obtained in two-foot increments immediately below the hollow stem auger. After driving and extracting the split spoon through the augers, samples will be removed and the auger will be advanced to the next sampling depth. All soil produced during drilling and not retained as samples will be drummed and sampled to determine disposal requirements.

The bedrock well will be installed utilizing a combination of hollow stem augers and air or mud-rotary drilling. The specific drilling method chosen will be decided in the field and will be based on site-specific drilling conditions. If a caving condition is encountered in the formation during drilling with air rotary, two alternate courses of action are applicable. It will first be attempted to utilize an "undereamer", which is an air rotary drilling tool in which the casing is installed as the formation is drilled. If such a tool is not available, it will be necessary to utilize mud rotary drilling to prevent formation caving and allow for installation of casing. This method will only be used, if needed, for overburden drilling of the bedrock well.

Bedrock will be cored in order to determine the depth of competent bedrock utilizing an NX/NQ double-tube core barrel in accordance with Standard Method ASTM D-213-70. Competent bedrock will be established when a core sample has a Rock Quality Designation (RQD) of at least 50%. The RQD represents a modified form of recording rock core recovery and indicates the degree of fracturing of the bedrock. The RQD is defined as follows:

$$\% \text{ RQD} = \frac{100 \text{ X Length of core in pieces 4" and larger}}{\text{Hole length actually drilled}}$$

The RQD is determined by totaling the lengths of core four inches and longer, while differentiating between natural breaks (joints, open bedding planes, etc.) and breaks caused by drilling. Breaks caused by drilling are not counted as breaks when measuring core lengths for determination of RQD. Natural breaks in the core are distinguished by the presence of weathering products, secondary deposits, dullness and rounding produced by solution, and slickensides. The hole will then be enlarged to 10 inches in diameter using air rotary drilling and a 6-inch stainless steel casing will be tremmie grouted into the hole to seal off the overburden aquifer and fractured bedrock zone. After an appropriate set period, drilling will resume with a 5 3/4-inch roller bit into the uppermost water-bearing zone.

All monitor wells will be installed in accordance with NJDEP Unconsolidated and Bedrock Monitor Well Specifications provided in Appendix C. Well construction diagrams will be completed for each well installed. All drilling will be performed by a New Jersey licensed well driller under the supervision of an IT Corporation geologist. The geologist will complete detailed stratigraphic boring logs for each boring using the Unified Soil Classification System which will be included in the investigation report.

The overburden monitor well will be constructed of 4-inch diameter schedule 40 PVC riser and 0.01-inch slot screen. Only threaded-joint well casing will be used for well installation. The installation procedure includes placement of a bentonite pellet seal at the bottom of each drilled hole to prevent possible leakage from the overburden to the bedrock aquifer. The gravel pack around the screen consists of number one sand which extends to approximately 2-3 feet above the well screen. A two-foot bentonite seal, followed by a cement-bentonite slurry (8 gallons of water to 5 pounds of dry bentonite per 94-pound bag of cement) will be used to seal the annulus around the well. The bedrock well MW-2-BR will be constructed of 6-inch diameter steel casing seated in competent bedrock. Upon placement of the casing into the borehole, the well annulus will be sealed with cement/bentonite grout. An open hole will exist in the bedrock below the steel casing. The well casings for both wells will be finished flush with ground surface in order to avoid disruption of NAPC operations at this location.

Upon installation, the wells will be developed for a period of one hour through low yield sustained pumping, or until all sediment fines are removed from the discharge water. All development water will be either discharged to the ground or to the on-site wastewater treatment plant unless contamination is noted. If contamination is noted, all water will be drummed and separated (if oil) or held for analytical testing and appropriate disposal.

6.3 GROUND WATER SAMPLING AND ANALYSIS

The two proposed monitor wells will be allowed to stabilize for a minimum of two weeks after installation before sampling. Ground water samples will be collected with teflon bailers which were cleaned in the laboratory following the decontamination procedures outlined in section 6.4. Following cleaning, each bailer will be wrapped in aluminum foil (with the shiney side of the foil on the outside) and fitted with a stainless steel leader. A separate bailer will be used for each sample taken.

Prior to monitor well sampling, ground water measurements will first be obtained followed by the evacuation of three to five casing volumes of standing water from each well. This water will be contained in drums. If contamination is noted, the water will be disposed of accordingly, otherwise it will be discharged to the on-site wastewater treatment plant.

Water samples will be shipped within 24 hours of sample collection to the ITAS laboratory in Monroeville, Pennsylvania. Each ground water sample will be collected and stored in two, 40-ml glass vials with teflon septums and plastic caps. The samples will be analyzed for EG according to methodology presented in Appendix D.

Each sample will be individually labeled and placed in a sample shuttle and kept cool with ice packs. A chain-of-custody form will be completed by the field technician and will accompany the samples to the laboratory. In addition field and travel blanks will be submitted along with the water samples as part of quality assurance requirements described in Section 6.1.

6.4 DECONTAMINATION PROCEDURES

All soil and ground water sampling equipment will be decontaminated prior to use on site and between all samples. Decontamination of all non-heavy equipment will be performed on a decontamination pad at a location to be specified in the field. The pad will be rectangular in shape and will consist of two 6-ml thick plastic liners, surrounded by wood timbers, placed under the plastic on all sides to prevent the release of de-con material. All water will be drummed for sampling to determine disposal requirements. Split spoons, hand augers, bailers, and other sampling equipment will be decontaminated after each use with the following procedures:

- Non-phosphate detergent and tap water wash.
- Tap water rinse.
- Distilled/Deionized water rinse.
- Hexane rinse.

- Distilled/Deionized water rinse.
- Total air dry.

The water generated from equipment cleaning will be drummed and sampled to determine disposal requirements.

6.5 SITE SAFETY TRAINING

Health and Safety (Tailgate) meetings will be conducted at the beginning of each work day, and/or whenever new employees arrive at the site. The health and safety considerations for that day's activities will be reviewed, and the protective equipment and other materials necessary to perform the work will be outlined. The Tailgate Health and Safety forms will be filled out for each meeting and will be signed by all personnel in attendance. The site Health and Safety Plan is attached as Appendix E.

7.0 PROJECT REPORTING

Execution of this investigation will involve the generation of two reports. The first report will be a draft site investigation report which will be submitted to the Navy within six weeks of completion of field work. This report will include, at a minimum, the following:

- Sample location map
- Detailed description of the field investigation, including a summary of sampling, analyses, and testing
- Soil boring logs and monitor well consruction diagrams
- Analytical results of all chemical sampling performed and results of other testing completed
- Two perpendicular stratigraphic geologic cross-sections of the site focused on the spill area
- Sample results evaluation
- Assessment of need for site remediation due to the EG spill
- Remedial Action Techniques Summary and Feasibility

Upon submittal of the draft report to the Navy, IT will then make a formal presentation of the report to NAPC, as directed by the EIC. After receipt of comments on the report from NAPC and the EIC, the final report will be prepared and submitted to the Navy within three weeks.

8.0 PROJECT COMPLETION SCHEDULE

The field investigation proposed herein can be accomplished wihin a three-week time period once field activities are initiated. Upon contract modification, one to three weeks of time will be necessary to schedule IT personnel, subcontractors, and laboratory services. Therefore, the estimated startup date for the field investigation would be approximately one to three weeks after the contract modification date. Upon completion of field activities it will take approximately four to six weeks for analytical data turnaround.

A First Draft Site Investigation Report will be submitted to the Navy within six weeks of the completion of the field investigation, provided there are no extensive delays in receipt of the analytical data from the laboratory.

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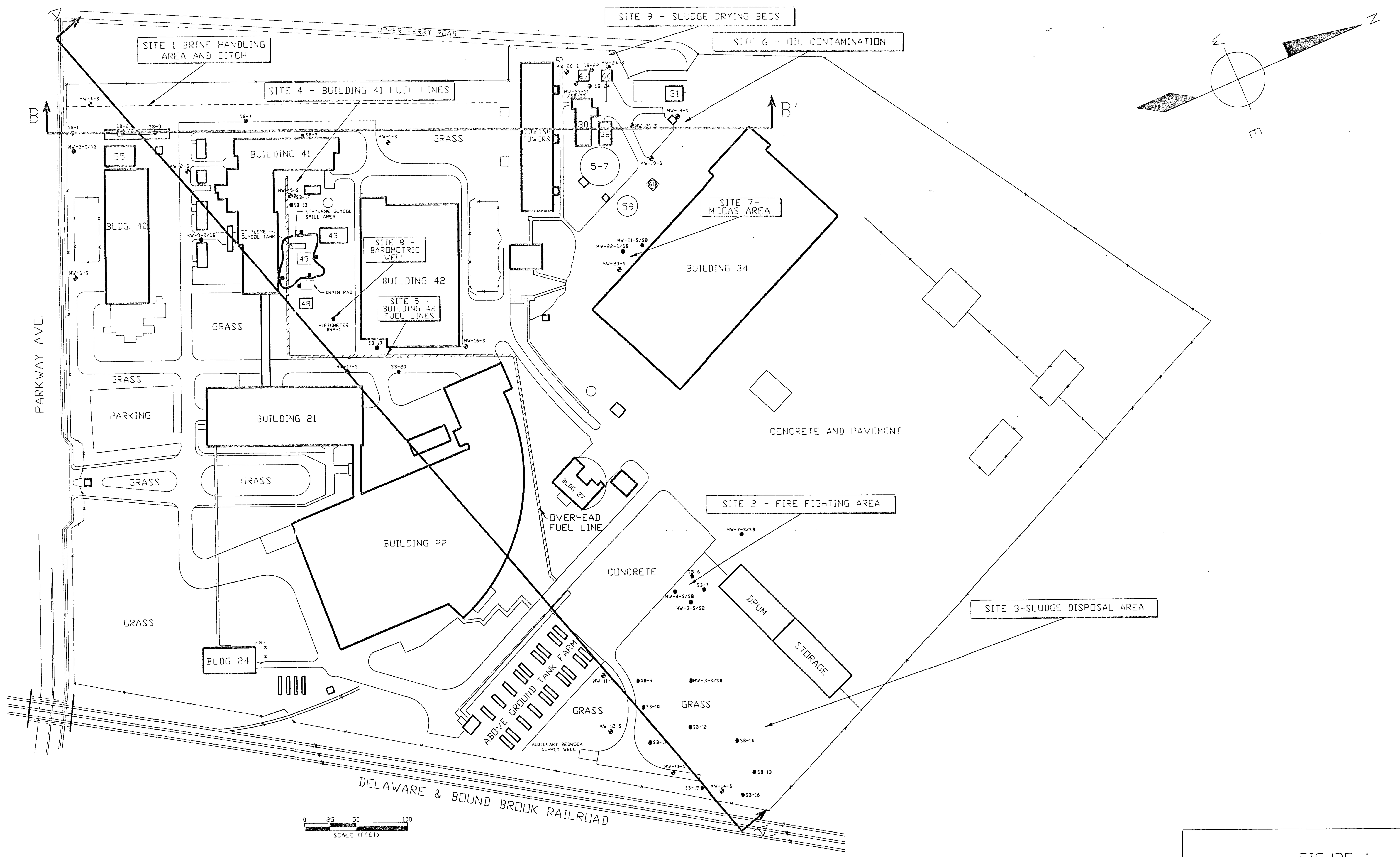
TABLE 1
SUMMARY OF PROPOSED SAMPLING AND TESTING

Sample Location/No.	No. of Samples/Tests	Sample Media	Sample Type	Sampling Depth	Analytical Parameter	Sampling Rationale
PHASE I						
SB-26 through SB-34	9	Soil	Hand auger	1-foot interval above water table	Ethylene glycol, priority pollutant metals (SB-28 only)	Delineate extent of potential soil contamination in spill area
MW-27-S	1	Soil	Soil boring above water table	2-foot interval	Ethylene glycol	Delineate lateral extent of potential soil contamination
SB-27, GS-1 SB-32, GS-1	2	Soil	Hand auger, Geotechnical	Will be field determined	Grain size analysis	Determine grain size of overburden within spill area
MW-2-BR, ST-1	1	Soil	Soil boring, Geotechnical	Will be field determined	Permeability analysis	Determine permeability of overburden aquifer
MW-2-BR, CS-1	2,5 ft. Cores	Bedrock	Core sample	Upper 10' of bedrock	Rock quality designation (RQD)	Determine depth of competent bedrock
MW-15-S, MW-17-S, MW-27-S, BRP-1, MW-2-BR(1)	5	Ground water	Grab	--	Ethylene glycol, priority pollutant metals (MW-15-S only)	Determine impact of spill on ground water and extent of potential ethylene glycol contamination in overburden and bedrock
PHASE II						
MW-15-S and MW-27-S	2	Saturated zone	Slug test	--	Hydraulic conductivity and transmissivity	Determine hydraulic conductivity and transmissibility of overburden aquifer
B.S.-1 through B.S.-5	6	Soil	Hand Auger	Will be field determined	Bacterial enumeration, nitrogen and phosphorus, pH, microbial stimulation	Determine suitability of soils for bioremediation
Field Blanks	2	1 each for soil and ground water sampling	--	--	Ethylene glycol, priority pollutant metals	Quality assurance-sampling equipment decontamination
Trip Blanks	2	1 per sample shipment	--	--	Volatile organics, including ethylene glycol	Quality assurance check for cross contamination

Note: (1) Includes newly installed monitor wells MW-27-S and MW-2-BR.



LEGEND

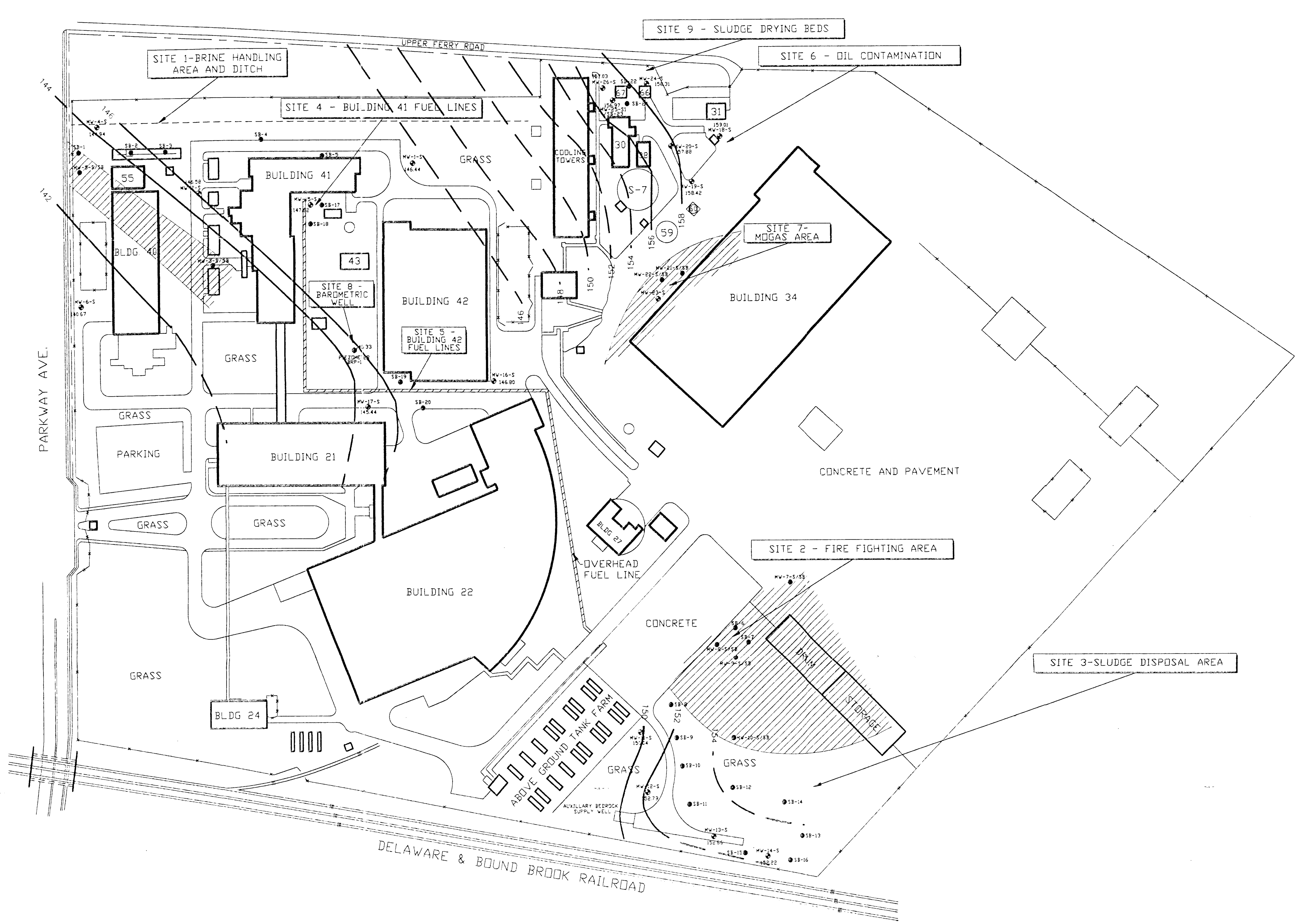
- ■ CATCH BASIN
- ◈ OVERBURDEN MONITOR WELL LOCATION
- ● SOIL BORING SAMPLING LOCATION

FIGURE 1
SITE MAP
Prepared For:
NAVAL AIR PROPULSION CENTER
TRENTON, NEW JERSEY
PROJECT No. 529234
OCTOBER 1989

INTERNATIONAL TECHNOLOGY CORPORATION

DRAWN BY	M.S.M.	CHECKED BY	APPROVED BY	DRAWING NUMBER
	2/27/89			529234B1

DRAWN BY R.K.R. 10/4/89 | CHECKED BY | APPROVED BY | DRAWING NUMBER 52923402



LEGEND

- OVERBURDEN MONITOR WELL LOCATION
- SOIL BORING SAMPLING LOCATION
- GROUND WATER ELEVATION (MSL)
- AREAS WITH NO WATER ENCOUNTERED IN OVERBURDEN
- GROUND WATER CONTOUR LINE (DASHED WHERE INFERRED)

FIGURE 2
OVERBURDEN GROUND WATER CONTOUR MAP FOR APRIL 1989 SAMPLING

Prepared For:
NAVAL AIR PROPULSION CENTER
TRENTON, NEW JERSEY
PROJECT No. 529234
OCTOBER 1989

INTERNATIONAL TECHNOLOGY CORPORATION

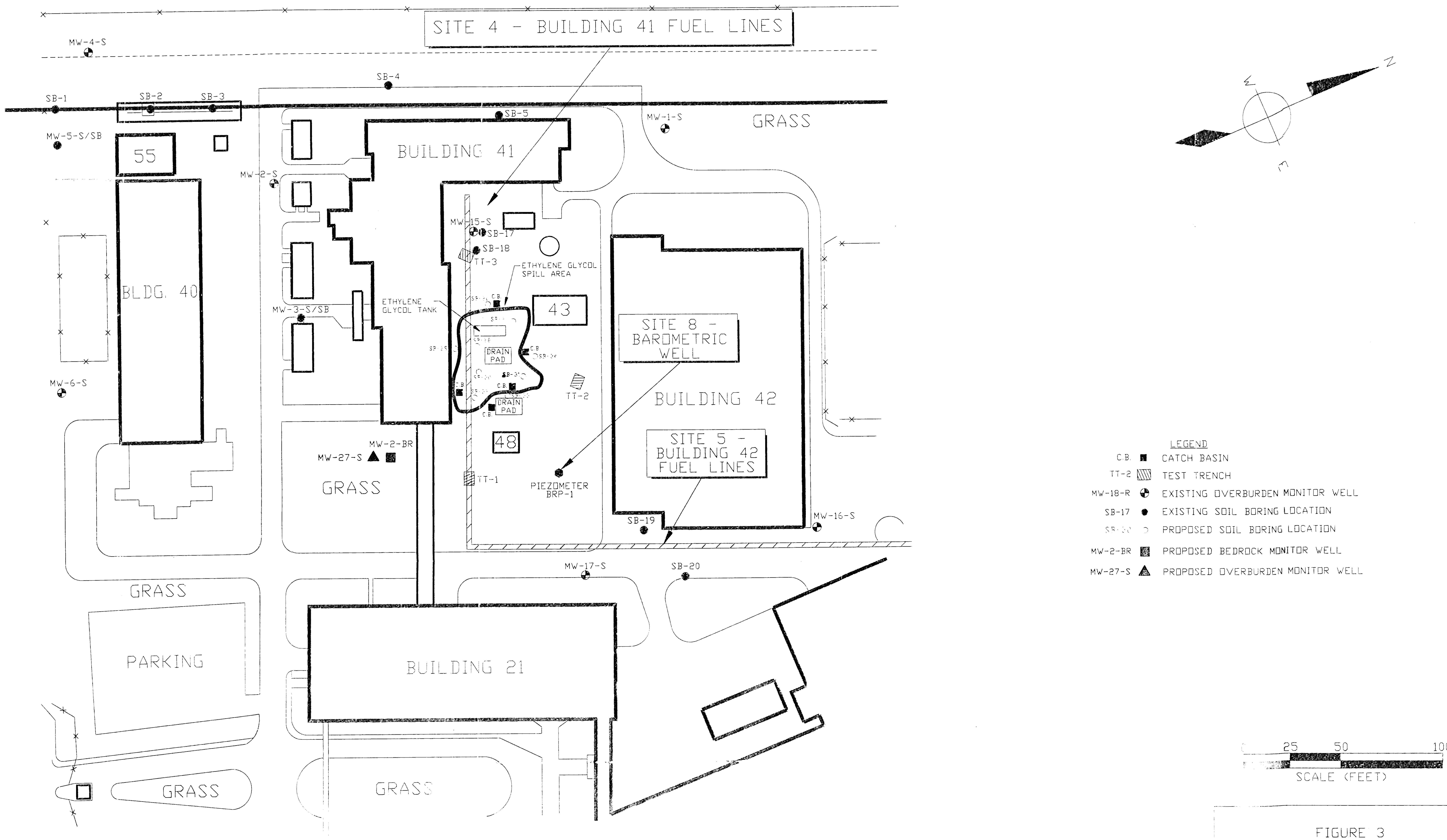


FIGURE 3
SAMPLE LOCATION MAP
Prepared For:
...L AIR PROPULSION CENTER
TRENTON, NEW JERSEY
PROJECT No. 529234
OCTOBER 1989

INTERNATIONAL TECHNOLOGY CORPORATION

DRAWING NUMBER 52923403
CHECKED BY
APPROVED BY
DRAWN BY M.S.M. 2/27/89

APPENDIX A

TEST TRENCH GROUND WATER SAMPLE DATA

Rancocas Environmental Laboratories, Inc.
502 Burlington Avenue • Delanco, New Jersey 08075 • (609) 461-8830

CLIENT: 0813.10
Officer in Charge, NAVFAC Contracts
Naval Air Propulsion Center
P.O. Box 7176
Trenton, N.J. 08628-0176

Attention: Mr. Larry Quinn, PW 322

Analysis Report No.

Sample Identification: Trenchs
Contract No.: N62472-87-D-9569
Purch Request No.: N62376-89-RC-00016
Log Number: 89-1221 thru 89-1226
Collected By: Client
Date Sample Collected: as below
Collection Time: as below
Date Received 2-21-89
Date Completed 2-27-89
Date of Report 3-15-89

Results mg/l unless otherwise specified

Log #	Sample ID	Date Collected	Time Collected	Ethylene Glycol
89-1221	#1-1	2-10-89	N/A	* <2.0
89-1222	#1-2	2-17-89	3:10	* <2.0
89-1223	#2-1	2-10-89	N/A	* <2.0
89-1224	#2-2	2-17-89	11:35	* <2.0
89-1225	#3-1	2-10-89	N/A	* <2.0
89-1226	#3-2	2-17-89	12:50	* <2.0

*= Analysis performed by WT NJDEP 77371

Laboratory Manager

NJDEP NO. 03151

astex Industries, Inc.
Licensed Analytical Laboratories

P.A. DER 46005
N.J. DEP 77371

28 S. Hanover Street Pottstown, PA. 19464 215/327-0880 FAX 215/327-9608
125 Main Avenue Elmwood Park, N.J. 07407 201/791-6700

P.O. # 8714
Sample # 890227.032

ustomer # rancoc
For Rancocas Environmental
502 Burlington Avenue
Delanco NJ 08075
Attn: Sondra

---

ate Sampled 2-10-89 Date Rec. 2-27-89 11:25 AM
Sampled By customer Rec by SLG
Sample grab PWS ID
Sample ID #89-1221 Groundwater Rel. test trench #1 Sample 1-1

Organics		
Ethylene Glycol	<2	mg/1

Signature Patrick A. Carlon

Wastex Industries, Inc. P.A. DER 46005
N.J. DEP 77371

Licensed Analytical Laboratories

28 S. Hanover Street Pottstown, PA. 19464 215/327-0880 FAX 215/327-9608
125 Main Avenue Elmwood Park, N.J. 07407 201/791-6700

P.O. # 8714
Sample # 890227.033

Customer # rancoc
For Rancocas Environmental
502 Burlington Avenue
Delanco NJ 08075
Attn: Sondra

Date Sampled 2-17-89 3:10 PM Date Rec. 2-27-89 11:25 AM
Sampled By LQ Rec by SLG
Sample grab PWS ID
Sample ID #89-1222 Groundwater Rel. test trench #1 Sample 1-2

Organics

Ethylene Glycol	<2	mg/l

Signature Patrick A. Conlon

Wastex Industries, Inc. P.A. DER 46005
N.J. DEP 77371

Licensed Analytical Laboratories

28 S. Hanover Street Pottstown, PA. 19464 215/327-0880 FAX 215/327-9608
125 Main Avenue Elmwood Park, N.J. 07407 201/791-6700

P.O. # 8714
Sample # 890227.034

Customer # rancoc
For Rancocas Environmental
502 Burlington Avenue
Delanco NJ 08075
Attn: Sondra

Date Sampled 2-10-89 Date Rec. 2-27-89 11:25 AM
Sampled By customer Rec by SLG
Sample grab PWS ID
Sample ID #89-1223 Groundwater Rel. test trench #2 Sample 2-1

Organics

Ethylene Glycol	<2	mg/1

Signature Patrick A. Conlon

Wastex Industries, Inc.

Licensed Analytical Laboratories

P.A. DER 46005
N.J. DEP 77371

28 S. Hanover Street, Pottstown, PA. 19464 215/327-0880 FAX 215/327-9608
125 Main Avenue Elmwood Park, N.J. 07407 201/791-6700

P.O. # 8714
Sample # 890227.035

Customer # rancoc
For Rancocas Environmental
502 Burlington Avenue
Delanco NJ 08075
Attn: Sondra

Date Sampled 2-17-89 11:35 AM   Date Rec. 2-27-89 11:25 AM
Sampled By LQ   Rec by SLG
Sample grab   PWS ID
Sample ID #89-1224 Groundwater Rel. test trench #2 Sample 2-2

Organics

Ethylene Glycol	<2	mg/l

Signature Patrick A. Conlon

Wastex Industries, Inc.
Licensed Analytical Laboratories

P.A. DER 46005
N.J. DEP 77371

28 S. Hanover Street Pottstown, PA. 19464 215/327-0880 FAX 215/327-9608
125 Main Avenue Elmwood Park, N.J. 07407 201/791-6700

P.O. # 8714
Sample # 890227.036

Customer # rancoc
For Rancocas Environmental
502 Burlington Avenue
Delanco NJ 08075
Attn: Sondra

Date Sampled 2-10-89
Sampled By customer
Sample grab
Sample ID #89-1225 Groundwater Rel. test trench #3 Sample 3-1

Date Rec. 2-27-89 11:25 AM
Rec by SLG
PWS ID

Organics		
Ethylene Glycol	<2	mg/l

Signature Patrick A. Conlan

Wastex Industries, Inc.
Licensed Analytical Laboratories

P.A. DER 46005
N.J. DEP 77371

28 S. Hanover Street   Pottstown, PA.   19464   215/327-0880   FAX 215/327-9608
125 Main Avenue   Elmwood Park, N.J. 07407   201/791-6700

P.O. # 8714
Sample # 890227.037

Customer # rancoc
For Rancocas Environmental
502 Burlington Avenue
Delanco NJ 08075
Attn: Sondra

Date Sampled	2-17-89 12:50 PM	Date Rec.	2-27-89 11:25 AM
Sampled By	LQ	Rec by	SLG
Sample	grab	PWS ID	

Sample ID #89-1226 Groundwater Rel. test trench #3 Sample 3-2

Organics

Ethylene Glycol	<2	mg/l

Signature ____________________

Rancocas Environmental Laboratories, Inc.
502 Burlington Avenue • Delanco, New Jersey 08075 • (609) 461-8830

CLIENT: 0813.10
Officer in Charge, NAVFAC Contracts
Naval Air Propulsion Center
P.O. Box 7176
Trenton, N.J. 08628-0176

Attention: Mr. Larry Quinn, PW 322

Analysis Report No. 20748

Sample Identification: Test Trench #2-3
Contract No.: N62472-87-D-9569
Purch Request No.: N62376-89-RC-00016
Log Number: 89-1725
Collected By: REL
Received 3-13-89
Completed 3-15-89

Results mg/l unless otherwise specified

Parameter	89-1725
Ethylene Glycol	* <5.0

* Analysis performed by WT NJDEP 77371

Laboratory Manager

NJDEP NO. 03151

Wastex Industries, Inc.
Licensed Analytical Laboratories

P.A. DER 46005
N.J. DEP 77371

28 S. Hanover Street Pottstown, PA. 19464 215/327-0880 FAX 215/327-9608
125 Main Avenue Elmwood Park, N.J. 07407 201/791-6700

P.O. # 8727
Sample # 890313.035

Customer # rancoc
For Rancocas Environmental
502 Burlington Avenue
Delanco NJ 08075
Attn: Sondra

Date Sampled 2-28-89 1:50 PM — Date Rec. 3-13-89 1:15 PM
Sampled By LQ, NAPC — Rec by SLG
Sample grab — PWS ID
Sample ID #89-1725 Test Trench #2 sample 2-3

Organics

Ethylene Glycol	<5	mg/l

Signature Patrick A. Conlon

APPENDIX B

ETHYLENE GLYCOL LITERATURE SEARCH INFORMATION

ETHYLENE GLYCOL LITERATURE REFERENCES

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APPENDIX C

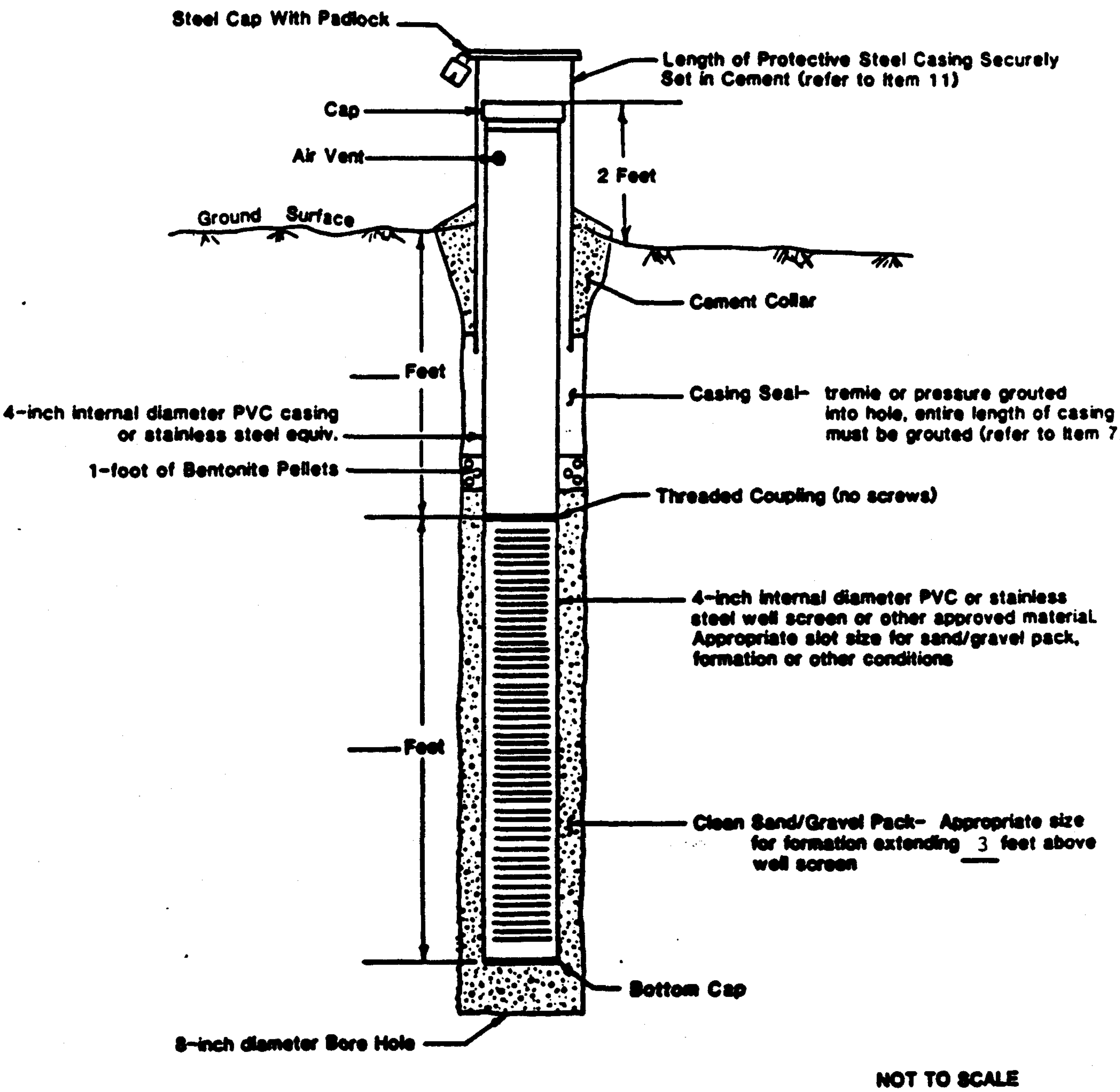
NJDEP UNCONSOLIDATED AND BEDROCK MONITOR WELL SPECIFICATIONS

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONITOR WELL SPECIFICATIONS FOR
UNCONSOLIDATED FORMATIONS

SITE NAME : Naval Air Propulsion Center

LOCATION : Trenton, New Jersey

DATE : October 1989



NJGS Revised 9-87

MONITORING WELL REQUIREMENTS FOR UNCONSOLIDATED FORMATIONS
Revised 9/87

1. Notification to the NJDEP is required two weeks prior to drilling.

2. State well permits are required for each monitoring well constructed by the driller. The well permit tag must be permanently affixed to each monitoring well.

3. Copies of the site specific well specifications must be maintained at the drilling site by the driller.

4. The monitoring well must be installed by a New Jersey licensed well driller.

5. Monitoring well design must conform with NJAC 7:9-7, 8, and 9.

6. The borehole diameter must be a minimum of 4 inches greater than the casing diameter.

7. Acceptable grouting materials are:

   Neat Cement - 6 gallons of water per 94 pound bag of cement.

   Granular Bentonite - 1 gallon of water per 1.5 pounds of bentonite.

   Cement-Bentonite - 8 gallons of water to 5 pounds of bentonite dry mixed per 94 pound bag of cement.

   Cement-Bentonite - 10 gallons of water per 8 pounds of bentonite water-mixed with a 94 pound bag of cement.

   Non-expandable cement - 7.5 gallons of water per 1/2 teaspoon of aluminum hydroxide mixed with 4 pounds of bentonite and 94 pounds of cement.

   Non-expandable cement - 7 gallons of water per 1/2 teaspoon of aluminum hydroxide mixed with 94 pounds of cement (Type I or Type II).

8. Potable water must be used for mixing grouting materials and drilling fluids.

9. Only threaded joints are acceptable as couplings.

10. The driller must maintain an accurate written log of all materials encountered, record construction details for each well, and record the depths water bearing zones. This information must be submitted to the Bureau of Water Allocation as required by N.J.S.A. 58:4A.

11. A length of protective steel casing with a locking cap must be securely set in cement around the well casing. Flush mount monitoring wells are acceptable provided they have manholes, locking caps, and seals to prevent leakage of surface water into the well.

12. Top of each well casing (excluding cap) must be surveyed to the nearest 0.01 foot by a New Jersey licensed surveyor. The survey point must be marked on each well.

13. Wells must be developed to a turbidity-free discharge.

14. Modifications to designs are allowed only with NJDEP approval.

Additional Requirements (if checked):

Split Spoon Samples ( ) Continuous to bedrock

Borehole Geophysical Logs ( ) ______

Top of Screen set 3 feet above/~~below~~ water table

Dedicated Bailer (Sampler) in Well ( ) ______

Other ( ) Screens will extend to just above bedrock.

______

______

Notice is Hereby Given of the Following:

Review by the Department of well locations and depths is limited solely to review for compliance with the law and Department rules.

The Department does not review well locations or depths to ascertain the presence of, nor the potential for, damage to any pipeline, cable, or other structures.

The permittee (applicant) is solely responsible for the safety and adequacy of the design and construction of monitoring well(s) required by the Department

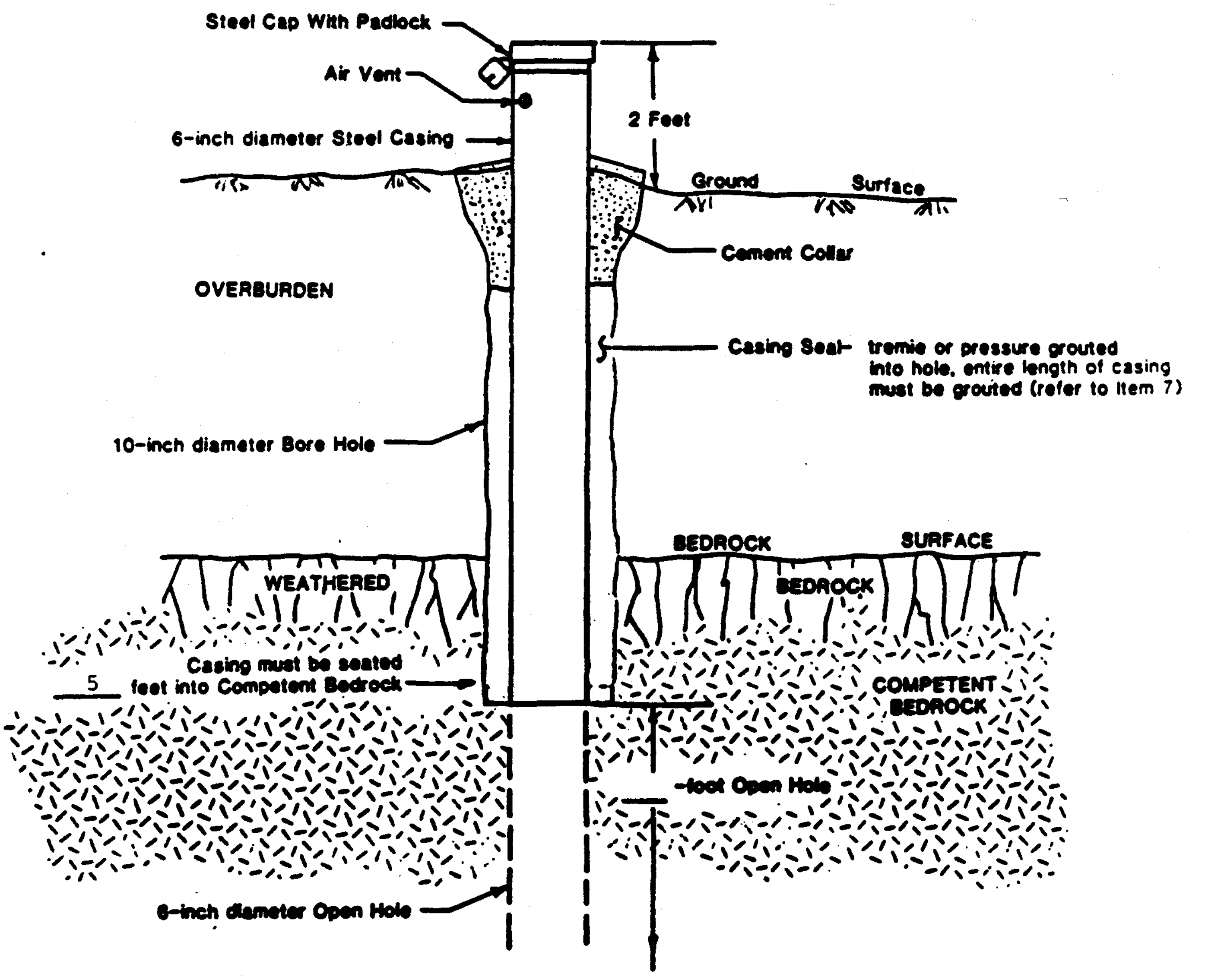
The permittee (applicant) is solely responsible for any harm or damage to person or property which results from the construction or maintenance of any well; this provision is not intended to relieve third parties of any liabilities or responsibilities which are legally theirs.

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
MONITOR WELL SPECIFICATIONS FOF.
BEDROCK FORMATIONS

SITE NAME : Naval Air Propulsion Center

LOCATION : Trenton, New Jersey

DATE : October 1989



NOT TO SCALE

NJGS Revised 9-87

BEDROCK MONITORING WELL REQUIREMENTS
Revised 9/87

1. Notification to the NJDEP is required two weeks prior to drilling.

2. State well permits are required for each monitoring well constructed by the driller. The well permit tag must be permanently affixed to each monitoring well.

3. Copies of the site specific well specifications must be maintained at the drilling site by the driller.

4. The monitoring well must be installed by a New Jersey licensed well driller.

5. Monitoring well design must conform with NJAC 7:9-7, 8, and 9.

6. Drill an oversize borehole a minimum of 4 inches greater than the casing diameter through the overburden and bedrock so that the casing can be sealed into competent rock as indicated in the diagram.

7. Acceptable grouting materials are:

   Neat Cement - 6 gallons of water per 94 pound bag of cement.

   Granular Bentonite - 1 gallon of water per 1.5 pounds of bentonite.

   Cement-Bentonite - 8 gallons of water to 5 pounds of bentonite dry mixed per 94 pound bag of cement.

   Cement-Bentonite - 10 gallons of water per 8 pounds of bentonite water-mixed with a 94 pound bag of cement.

   Non-expandable cement - 7.5 gallons of water per 1/2 teaspoon of aluminum hydroxide mixed with 4 pounds of bentonite and 94 pounds of cement.

   Non-expandable cement - 7 gallons of water per 1/2 teaspoon of aluminum hydroxide mixed with 94 pounds of cement (Type I or Type II).

8. Potable water must be used for mixing grouting materials and drilling fluids.

9. Only threaded or welded joints are acceptable as couplings.

10. The driller must maintain an accurate written log of all materials encountered, record construction details for each well, and record the depth of water bearing zones. This information must be submitted to the Bureau of Water Allocation as required by N.J.S.A. 58:4A.

11. Flush mount monitoring wells are acceptable provided they have manholes, locking caps, and seals to prevent leakage of surface water into the well.

12. Top of each well casing (excluding cap) must be surveyed to the nearest 0.01 foot by a New Jersey licensed surveyor. The survey point must be marked on each well.

13. Wells must be developed to a turbidity-free discharge.

14. Modifications to designs are allowed only with NJDEP approval.

Additional Requirements (if checked):

Split Spoon Samples ( ) ______________________________

Rock Core Samples ( ) ______________________________

Borehole Geophysical Logs ( ) ______________________________

Dedicated Bailer (Sampler) in Well ( ) ____________________

Other ( ) ______________________________________

____

____

Notice is Hereby Given of the Following:

Review by the Department of well locations and depths is limited solely to review for compliance with the law and Department rules.

The Department does not review well locations or depths to ascertain the presence of, nor the potential for, damage to any pipeline, cable, or other structures.

The permittee (applicant) is solely responsible for the safety and adequacy of the design and construction of monitoring well(s) required by the Department

The permittee (applicant) is solely responsible for any harm or damage to person or property which results from the construction or maintenance of any well; this provision is not intended to relieve third parties of any liabilities or responsibilities which are legally theirs.

APPENDIX D

ANALYTICAL METHODOLOGY FOR ETHYLENE GLYCOL ANALYSIS

ENG/bj733-appA

STANDARD OPERATING PROCEDURE FOR ETHYLENE GLYCOL ANALYSIS
Based on SW-846 Method 8015

1.0 SCOPE AND APPLICATION

1.1 This SOP details the procedure followed by ITAS Pittsburgh for the analysis of ethylene glycol in water and soil samples. Direct injection is used in the case of water samples, while an extraction procedure followed by direct injection of the extract, is needed for the soils.

2.0 PREPARATION OF WATER SAMPLES

2.1 Samples are injected directly from their respective vials.*

*NOTE: Vials Do Not contain any preservatives.

2.2 Directly inject D.I. water as Method Blank.

3.0 PREPARATION OF SOIL SAMPLES

3.1 Weigh approximately 5.0 g of soil into a 5.0 ml vial.

3.2 Add 5.0 ml D.I. water by way of pipett.

3.3 Place on shaker for approximately one hour.

3.4 Allow time for soil to settle out or place on centrifuge.

3.5 Directly inject sample onto the column. Be sure not to inject particles into the GC.

3.6 Use a soil blank prepared by IT Pittsburgh Laboratory.

4.0 GC METHOD

4.1 Column used for analysis is a 80/100 Carbopack C/0.8% THEED. Maximum column temperature = 115°.

4.2 Operating Conditions:

Initial Temperature	= 115° Isothermal
Initial Time	= 9.0 minutes
Injector Temperature	= 120°
Detector Temperature	= 120° FID
Attenuation	= 1
Flow Rate	= 20 ml/min

Integrator Parameters

Zero = 5
A = 2 1
CHT SP = 0.5
PK WD = 0.40
THRSH = 0
Air Rej = 0

Elution Time = -6.5 minutes.

4.3 Standard Preparation:

4.3.1 Three point standard curve is used ranging from 3.0 ug/ml to 20 ug/ml.

4.3.2 To make stock solution, measure 40 ml D.I. water into VOA vial. Add 250 ul ethylene glycol. Calculate approximate concentration and dilute to make range of standards needed.

5.0 OPERATION

5.1 Establish a 3 point calibration curve with RSD < 25%.

5.2 After highest standard is run, flush system out with D.I. water until carry-over is no longer evident.

5.3 Inject the blank followed by samples.

5.4 Flush system with D.I. water between runs if ethylene glycol is present and carry-over is obvious.

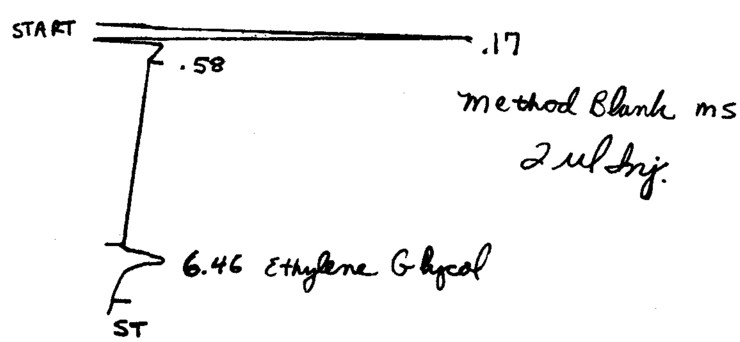
5.5 Run a 3 point curve at the end and average all standards before calculating.

5.6 Run a Method Spike and a Method Spike Duplicate with all samples.

5.7 Injection volume is 2ul.

6.0 CALCULATIONS

6.1 Sample Calculations:



Run #180 4/26/89 EG ZRF = .301

Area %

RT	Area	Type	AR/HT	Area %
0.17	79938	D BP	0.111	54.885
0.58	22335	PB	0.226	15.889
0.46	45747	BB	0.474	30.906

Total Area = 148020
MUL Factor = 1.000E+00

6.2 Ethylene Glycol Calculations:

$$\text{Concentration} = \frac{\text{Total Area}}{\text{Rf(ug/ml)}} \times \text{dilution} = \text{ug/ml}$$

$$\text{\% Recovery} = \frac{\text{Observed Concentration}}{\text{Expected Concentration}} = \text{\%}$$

Expected Concentration =

$$\frac{\text{Conc. of Std. * Amt Injected}}{\text{Total Volume}} = \text{ug/ml}$$

APPENDIX E

HEALTH AND SAFETY PLAN

INVESTIGATION OF ETHYLENE GLYCOL SPILL
AREA BETWEEN BUILDINGS 41 AND 43
FOR
NAVAL AIR PROPULSION CENTER
TRENTON, NEW JERSEY

PREPARED BY:

IT CORPORATION
165 FIELDCREST AVENUE
EDISON, NEW JERSEY 08837

NOVEMBER 1989

TABLE OF CONTENTS
HEALTH AND SAFETY PLAN

TABLE OF CONTENTS
(Continued)

1.0 HEALTH AND SAFETY PLAN

1.1 INTRODUCTION

This health and safety plan will be implemented and followed by IT personnel and subcontractors during the collection of sub-surface soil samples, installation of ground water monitor wells, and the collection of ground water samples at the Naval Air Propulsion Center, Trenton, New Jersey. The site specific procedures to be followed at each area of concern are presented in Section 1.5 of this plan.

Organic compounds which may be found on-site include ethylene glycol, trichloroethylene, benzene, toluene and xylene. Metals and inorganic compounds which may be encountered include: arsenic, chromium, cadmium, lead, nickel and zinc. Some of these chemical constituents may be carried on airborne dust while others may volatilize and present a respiratory and/or contact health hazard. During field activities respiratory protection and protective clothing will be readily available and used as necessary. Different atmospheric conditions such as pressure, humidity, wind, temperature, and precipitation will have an effect on the concentration of the substances volatilized in the air.

Pathways of exposure exist on-site and the degree of hazard will vary widely. The following potential pathways of contamination may include:

(1) Dermal contact with contaminated soils and ground water
(2) Inhalation and ingestion of contaminated airborne particle and vapors
(3) Dermal contact with contaminated equipment.

All activities must be conducted so that the health and safety of the project personnel and the public are protected. The following program is designed for use during the aforementioned operations and includes specific health and safety procedures that should be followed in conjunction with any procedures stipulated by the Engineering Field Division (EFD) or other review group designated by the Navy.

The elements of the plan include procedures for personnel protection and training, personnel and equipment safety, medical surveillance, air quality monitoring, and general work practices. This plan also details the proper emergency procedures including emergency response, first-aid capabilities, and fire and spill control.

Provisions of the plan are intended to comply with, as a minimum, the following:

- Federal OSHA 29 CFR1910 and 1926.
- State of New Jersey Occupational Safety and Health Regulations.
- US EPA "Standard Operating Safety Guides" dated 11 November 1984.
- Navy Occupational Medical History (form OPNAV 5100/15 from OPNAVINST 5100.23B, Chapter 17).
- Safety and Health Guidelines for NACIP Confirmation Studies.
- IT Corporation Policy and Procedures relating to Health and Safety.

1.2 RESPONSIBILITIES

1.2.1 HEALTH AND SAFETY REPRESENTATIVE

The regional Occupational Safety and Health (OSH) representative will be responsible for technical development and coordination of the site health and safety program. This program will comply with established corporate procedures and those procedures stipulated by the client whichever are more stringent. The health and safety program includes information on medical programs, training requirements, hazard assessment, personnel air monitoring, personnel protective equipment, respiratory protection, field implementation, audits, and other related duties. Liaison with offices of USEPA, NJDEP and OSHA on matters relating to health and safety will be handled by the on-site Health and Safety coordinator. The individual will provide the on-site supervisor with details concerning the complete, work specific program.

1.2.2 SITE PROJECT MANAGER

The site project manager, Dana Boyadjian (alternate: Leo Frey), will be ultimately responsible for field implementation of the safety and health plan. This will include communication of the site requirements to all personnel participating in the project. Additional communication may be required by the site project manager to include supervision and consultation with the OSH representative regarding appropriate changes to the health and safety plan.

1.2.3 ON-SITE SUPERVISOR (HYDROGEOLOGIST, GEOLOGIST, ENGINEER)

The on-site supervisor is responsible for field implementation of the health and safety program. This includes communication of any particular requirements to all affected personnel, audits and consultations with the on-site Health and Safety coordinator.

1.2.4 TEAM MEMBERS

All team members will be responsible for understanding and complying with all site health and safety requirements. One member of the project group will be assigned the responsibility of cleaning and maintaining the health and safety equipment and the decontamination area. All members of this group will have been provided formal training regarding the hazards and protection involved with this particular project.

1.3 <u>MEDICAL SURVEILLANCE</u>

All IT personnel and subcontractors on site will have successfully completed a preplacement or periodic (annual) physical examination. This should comply with IT PRO 9410.1. This examination has been designed to comply with all regulatory requirements.

1.3.1 PREEMPLOYMENT, PERIODIC SURVEILLANCE, AND EXIT PHYSICALS

Tests that are performed for employment physicals include the following:

- Medical and occupational history which includes a history of any respiratory disease, alcohol intake, past history of hepatitis, exposure to hepatatoxic agents, blood transfusions, hospitalizations for exposure to vinyl chloride monomer. Genetic and environmental factors must be considered for personal, family and occupational histories.

- Physical examination with specific attention to detecting enlargement of spleen, liver or kidneys, or dysfunction in these organs, and for abnormalities in skin, connective tissues and pulmonary systems.

- Complete blood count and differential

- Urinalysis (dipstick and microscopic examination)

- Chest roentgenogram (x-ray)

- Audiometric examination

- Pulmonary function test ($FEV_{1.0}$ and FVC)

- SMA-25 or equivalent liver function test which includes total bilirubin, alkaline phosphatase, SGOT, SGPT, and GGT.

- EKG for employees over 45 years old or when other complications indicate the necessity

- Drug and alcohol screen.

1.3.2 BIOLOGICAL MONITORING

Depending upon work conditions and the degree of potential exposure, biological monitoring should be performed for those employees working in areas where exposure to lead is possible. The medical surveillance program recommended for certain individuals on the project are described below. The necessity of such testing will be dependent upon the initial airborne lead exposure monitoring and duration of work performed in these areas, as required by OSHA 29CFR, 1910.1025. The determination for biological monitoring will be made by the regional Health and Safety representative. At a minimum, the following tests should be performed prior to performing the previously stated field tasks and after completion of these tasks.

- Blood lead content. If the results indicate blood level above 40 ug/100 grams of whole blood, blood lead sampling shall be repeated every two weeks.

IT Health and Safety Department maintains all employee medical records in the Torrance, California office. These records are reviewed by the IT consulting physician, who is board certified in occupational medicine. IT will maintain all medical records for a period of 30 years, and a copy of these records will be made available to any employee for either review or copying upon request. In order to obtain a copy of the medical record, a written release order must be completed by the employee and submitted to the OSH representative.

The medical surveillance provided to employees includes a judgement by the medical examiner of the ability of the employee to use either positive or negative pressure respiratory equipment. Any employee found to have a medical condition which could directly or indirectly be aggravated by exposure to these chemical substances or by the use of respiratory equipment will not be employed for the project.

All part-time employees and all nonproject personnel visiting the site will be restricted unless evidence is presented that a medical examination covering all the above mentioned tests has been conducted with satisfactory results.

1.4 TRAINING

All employees who work on this particular jobsite will have completed a training program which includes, as a minimum, the following:

- Basic Safety Training - This course stresses the fundamentals of safety including the causes and prevention of slip, trip, and fall hazards, confined space entry, heat and/or cold stress illness and prevention.
- Hazards and Protection - This course deals with the identification, recognition, and safe work practices with toxic materials. The use and limitations of applicable protective clothing, respirators, and decontamination procedures. Respirator fit-test is provided to each employee attending the course.
- First Aid and CPR - It is necessary for some employees in this project group to have completed both first aid and CPR training.
- Site Specific Safety Training - This course covers the mandates of the project health and safety plan. In particular, this stresses emergency response procedures and the various health hazards.

- Qualified Person - This training covers, use, operation and limitations of field monitoring equipment. Site investigation and safety decision making based on field instrumentation is included as well as contingency planning for emergencies.

- Lead Health Hazards Training - Each employee shall be informed of the local and systemic toxicity of lead, the purpose and application of a medical surveillance program, decontamination and personal hygiene practices and a review of the standard.

Most employees have already completed all of the training described, except the site specific training and health hazard training. Any new employee who has not been to the formal training class will receive this training before beginning to work on the project. This will apply to all subcontractors working for IT Corporation.

Tailgate Safety Meetings will be conducted at the beginning of each workshift, or whenever new employees arrive on the jobsite. The health and safety considerations for that particular day's activities will be reviewed, and the protective equipment and other materials necessary to perform the work will be outlined.

1.5 SITE SPECIFIC CONCERNS

Based on a review of existing historical data for each area of concern, site inspections and discussion with Navy personnel, the following site specific activities will be observed during site investigations operations. It should be noted that the NAPC Environmental Officer will be the on-site contact between IT and NAPC. All requests for drilling approval and notification of changes to site safety condition will be made through him to NAPC.

Site 1

Prior to any drilling activities, all proposed sampling locations will be reviewed and approved by NAPC personnel. It is the intent of IT to conduct all drilling at least three feet from underground piping and maintain drilling equipment at least 5 feet from overhead piping or wires. Where this is not possible, on-site field judgements will be made and implemented only after approval of NAPC personnel.

Site 1 is within an area of bulk storage and overhead transport lines for a flammable solvent, trichloroethylene. However, not all sample locations are within this storage and overhead line area. For those sample areas which are (Monitor Wells MW-2-BR and MW-27S), the potential exists to encounter an explosive air mixture.

During drilling for these activities, monitoring with both an LEL meter and organic vapor detector (see Sections 1.7.2 and 1.8.1) will be conducted. Should significant readings be determined (see sections 1.7.2 and 1.8.1) then operations will be stopped until the readings are low enough to continue. Upon re-startup of operations the previously described modification to drilling, which reduce spark release, will be implemented. For the well locations several precautions will be taken to minimize the presence of ignition sources during drilling. They are:

- The drill rig will be grounded (if non-diesel powered)
- Exhaust from the drill rig will be fed into a tank of water
- No smoking will be allowed.

In addition to the above, it will also be necessary to close the road between Buildings 40 and 41 to traffic in both directions, for a radius of 50 feet from the drill rig. This will be coordinated with both NAPC security and the NAPC fire department. The road closing will be clearly blocked off with traffic cones or barricades.

Site 4

Should drilling be required at Site 4 the same precautions described for Site 1 will be taken except there will be no road closure. Site 4 is an area believed to have been exposed to several past leaks of jet fuel from overhead piping. In addition, the west end of Site 4 is adjacent to a drum storage area for combustible liquids, such as jet fuel and solvents. It is recommended that NAPC temporarily relocate these drums should drilling operations be required because of their close proximity to sample locations. The previously described spark minimization techniques for drill rig operation will be implemented at this site.

1.6 REGULATED AREAS

The work area will include three separate zones: an exclusion ("hot") zone, a contamination reduction zone, and a support zone.

The exclusion zone will consist of the entire area of suspected contamination during installation of monitor wells and soil borings. Particular safety concerns will be implemented during the sampling of subsurface soil. All employees will use proper personnel protective equipment when performing such work. The exclusion zone will be a defined area where there is a possible respiratory and/or contact health hazard. Unless otherwise noted this area will be a ten foot radius around the drilling operation, or at the point of soil or water collection. The location of the exclusion zone will be demarcated by cones, warning flags, barricading tape or equivalent.

Decontamination, when necessary, will be performed in the contamination reduction zone. All personnel entering or leaving the exclusion zone will pass through this area in order to prevent any cross-contamination and for the purpose of accountability. Tools and any equipment or machinery will be decontaminated in a separate designated location, according to the procedure in Section 6.3, Decontamination Procedures of the work plan. The decontamination of all personnel will be performed on site adjacent to the exclusion zone. Personal protective outer garments and respiratory protection will be removed in the contamination reduction zone and properly labelled as contaminated material.

The support zone will consist of an area outside the contamination reduction zone. The support zone will be located to prevent employees from being exposed to any organic vapors or dust levels above environmental levels. Eating, drinking, or smoking will be permitted in the support area only after washing both face and hands. Site personnel will shower as soon as possible after each shift.

1.7 SAFETY HAZARD ASSESSMENT

1.7.1 GENERAL WORK PRACTICES

All operators of heavy equipment used on site will be properly trained in the operation of such equipment. The site supervisor will be responsible to check the proficiency of the operator. Perimeter barricades will be placed around the particular equipment used in a fixed location.

Only authorized personnel will be permitted in the exclusion and contamination reduction zones. These authorized individuals must have successfully completed a medical exam and have been properly trained in the use of respiratory protective equipment and specific health and safety hazards. A record of all personnel trained and medical qualifications will be maintained at the IT office. All visitors shall check with the NAPC and IT representatives before being allowed into the sampling areas.

An eye wash, fire extinguisher, and an emergency self-contained breathing apparatus (SCBA) will be made available at each decontamination line. In the event of an emergency, these materials will be ready for the worker's safety and protection. Any deviation from this site safety program must be discussed with the regional OSH representative.

Smoking will not be permitted on the premises except in the support areas or other specified locations. "NO SMOKING" signs will be conspicuously posted at the entrance to the exclusion zone if there exists a toxic atmosphere. Any employee not willing to comply with this procedure will be dismissed from the project immediately. Hot work may be permitted only after obtaining an authorized permit for that particular job assignment. The permit will be valid for only that work performed during specified times on that particular day.

At least one qualified person competent in both American Red Cross first-aid techniques and cardiopulmonary resuscitation (CPR) will be part of the team performing a specified task. A complete first-aid box will be readily available on site. If a serious injury occurs, the local hospital and ambulance will be summoned to evacuate the injured or ill person.

All generators larger than 3 KW will be equipped with a ground fault impedance circuit. In the event of a power surge, this circuit will trip and disconnect the electrical current. This protective measure is necessary to prevent electrical shock. Any electrical equipment, extension cords, or lights will be explosion proof. No other electrical equipment will be permitted in areas where there exists a flammable atmosphere. All static ignition sources will be identified and eliminated by the use of bonding and grounding techniques.

Material Safety Data Sheets (MSDS) will be obtained for every chemical product used on site. This information will be made readily available to all employees upon request and stored in a central location. MSDS or applicable information will be available with regard to materials used in the soil collection, water sample preservation and drilling process. All containers of any chemical products will be properly labeled to comply with the Federal OSHA Hazard Communication Standards (29 CFR 1910.1200).

1.7.2 SITE DRILLING

Site drilling will comply with the following rules:

1. Before drilling the existence and location of underground pipe, electrical equipment, gas lines or other utilities will be determined. This will be done by NAPC personnel during a site walk conducted with IT personnel prior to startup of the drilling program. No drilling will be conducted until the sample location is approved by NAPC.

2. No ignition sources are permitted if the ambient airborne concentration of flammable vapors exceeds 10 percent of the lower explosive limit (LEL) when drilling. A combustible gas indicator will be available to make this determination.

3. Operations must be suspended and corrective action taken if the airborne flammable concentration reaches 40 percent of LEL in the immediate area (a one-foot radius) of the point of drilling.

4. Operations must be suspended and corrective action taken if the flammable vapors exceed 10 percent of the LEL at a distance of greater than two feet from the point of drilling.

5. Combustible gas readings of the general work area will also be made, prior to drilling.

1.7.3 HEAVY EQUIPMENT OPERATION AND HEAVY MATERIALS HANDLING SAFETY

The following information warrants extra attention regarding work around heavy equipment (drill rig) and heavy materials:

- Use common sense.
- Hard hats are to be worn at all times on-site. Other protective gear as specified in the health and safety plan is applicable as well.
- Pay attention at all times.
- Maintain visual contact at all times.
- Establish hand signal communication when verbal communication is difficult. Specify one person per work group to give hand signals to equipment operators.
- Be aware of footing at all times.
- All heavy equipment will have backup alarms of some type.
- Only qualified people are to operate heavy equipment.
- Use chains, hoists, straps, and any other equipment to safely aid in moving heavy materials.
- Use proper personal lifting techniques. Use your legs, not your back.
- Never walk directly in back of or to the side of heavy equipment without the operator's knowledge.
- Never use a piece of equipment unless you are familiar with its operation. This applies to heavy as well as light equipment (e.g., chainsaws).
- Pipe sections and other materials to be utilized during this project are extremely heavy. Make sure all precautions have been taken prior to moving. Let the equipment, not your body do the moving.
- Be sure that no underground or overhead power lines, sewer lines, gas lines or telephone lines will present a hazard in the work area.
- Get help whenever you are in doubt about a material's weight. Use the buddy system.

1.7.4 POTENTIAL CHEMICAL EXPOSURE AND RESULTS OF PREVIOUS SITE STUDIES

As a result of the most recent site investigation (October 1989 to April 1989) the following contaminants were identified at each site listed below:

Site 1: Toluene, 1,2-Dichloroethylene, Trichloroethylene, Ethylbenzene, 1,1,2-Trichloroethane, Methyl Ethyl Ketone and Carbon Disulfide

Site 4: Ethylbenzene, Toluene, Xylene and Trichloroethylene

1.8 HEALTH STANDARDS

Threshold limit values refer to airborne concentration of substances which represent conditions that nearly all employees may be repeatedly exposed to day after day without adverse effect. These threshold limits are prescribed by the American Conference of Governmental Industrial Hygienists (ACGIH). They are based upon the best available information from industrial experience and animal or human studies.

These exposures are based upon the time-weighted average (TWA) concentration for a normal 8-hour workday and a 40-hour work week. Several chemical substances have short-term exposure limits or ceiling values which allow a maximum concentration to which workers can be exposed continuously for a short period of time without suffering from (1) irritation, (2) chronic or irreversible tissue damage, (3) narcosis of a sufficient degree to result in accidental injury, impair self-rescue, or substantially reduce work efficiency.

The short-term exposure limit (STEL) is defined, by the American Conference of Governmental Industrial Hygienists (ACGIH) in most cases, as a 15-minute time-weighted-average exposure which should not be exceeded within a two hour time period during a workday even if the 8-hour time weighted average is within current limits. Federal OSHA requires that a 15 minute "ceiling" concentration never be exceeded for that chemical constituent. This notation appears as the letter "C" after the chemical name.

Under certain chemical substance listings, there may appear a "skin" notation. This refers to the potential contribution to the overall exposure by the cutaneous route including mucous membranes and eye, either airborne or by direct contact. Little quantitative data is available describing absorption as a function of the concentration to which the skin is exposed. Biological monitoring will be considered to determine the relative contribution of dermal exposure to the total dose.

The following table represents the strictest set of guidelines currently established by either the ACGIH or federal OSHA.

TABLE 1

	TWA		STEL	
CHEMICAL SUBSTANCE	ppm	mg/m^3	ppm	mg/m^3
Arsenic	--	0.2	--	--
Chromium II III	--	0.5	--	--
Chromium VI	--	0.05	--	--
Cadmium[2] (dusts, salts)	--	0.05	--	0.2
Benzene[2]	10	--	25	--
Ethylene Glycol[3]	50	--	50	--
Lead	--	0.05	--	0.45
Selenium	--	0.2	--	--
Trichloroethylene	50	--	150	--
Nickel (metal and insoluable compounds)	--	1	--	--
Zinc Chloride	--	1	--	2
Zinc Oxide	--	5	--	10
Xylene[2]	100	--	--	--
Toluene[2]	100	--	150	--

[1]Vapor Pressure 58 mm Hg at 20°C
[2]Volatile components of motor fuel and aviation gasoline.
[3]Vapor pressure 0.06 mm Hg, saturation at 25°C is 79 ppm, over exposure outdoors is highly unlikely.

1.8.1 AIR QUALITY MONITORING

Routine area monitoring requirements can be categorized as continuous, real-time measurement of total organic vapors. Portable instruments are used to provide real-time, semiquantitative data on total organic vapor concentrations in and around the breathing zone of workers during the soil or water collection and core drilling operations. An HNU photoionization detector (10.2 V probe) or Photovac TIP will be used to measure total hydrocarbon concentrations in the air. Units will be calibrated using benzene standards.

If organic vapor concentrations are detected at any site in excess of twenty parts per million (20 ppm) in the breathing zone, Level B protection will be required at this point. Level B protection shall consist of either a self-contained breathing apparatus (SCBA) or air supply respiratory and Level C protective clothing.

When the qualified person (foreman or team member) observes sustained, HNU or TIP reading of 5 parts per million or greater, that person will take another measurement downwind at the perimeter of the site. If site perimeter readings are greater than half the prescribed value for the breathing zone, actions will be taken to reduce the off-site release of organic vapors in the air.

1.9 PERSONNEL PROTECTION

Equipment for personnel protection will be referenced to the potential contact and/or airborne levels of any vapor or dust contaminant, as stipulated by the Health and Safety Coordinator. Guidelines will be adhered to, pending evaluation of the site conditions. It will be the responsibility of the Health and Safety Coordinator to specify the level of protection required for site work.

1.9.1 LEVELS OF PROTECTION

Specific levels of protection will be used to safeguard IT employees on the job from potentially hazardous areas. Three distinct levels of protection may be required for this project. The final determination for IT personnel and subcontractors of any required level of protection will be based upon the hazards and current conditions of the worksite. The only person who may make this determination is the Health and Safety Coordinator. The situation requiring specific levels of protection are described in the following sections.

1.9.2 LEVEL B PROTECTION

Level B protection will be required when the maximum level of protection is needed due to the toxicity, or potential airborne concentrations. These levels of exposure will usually exceed by two times those recommended by ACGIH (TLV) or the OSHA Permissible Exposure Limit (PEL). This level of protection will be utilized when upgrade by Level C is required by the Health and Safety Representative.

The following equipment will be used for Level B protection:

- Self-contained breathing apparatus or air supplied respirator which are NIOSH/MSHA approved.
- Hooded, chemical resistant Polyethylene coated Tyvek® suit (Outer)
- Hooded, chemical resistant white Tyvek® (Inner)
- Gloves - (Outer) - chemical resistant Neoprene or Butyl rubber
- Gloves - (Inner) - chemical resistant (latex)
- Boots - (Outer) - chemical resistant Neoprene with steel toes
- Hard hat
- Hearing Protection (if necessary)

1.9.3 LEVEL C PROTECTION

Level C protection will be required when the toxic nature of the material and airborne concentration of suspected contaminants are known to be at or above the ACGIH Threshold Limit Value (TLV) or in sites where unknown exposure to metals may occur. This level of protection is the minimum level of protection utilized by IT personnel coming into contact with airborne concentrations of moderately toxic materials. This level of protection will be utilized whenever necessary during the soil boring drilling and excavation operations, and during decontamination of personnel, small tools, and equipment.

The following equipment will be used for Level C protection:

- Full face, air purifying respirators with organic vapor cartridges, and high efficiency particular filters which are NIOSH/MSHA approved. Half face respirators will be utilized if accompanied by chemical splash goggles and specified by the regional Health and Safety Coordinator. NOTE: Organic vapor cartridges will not provide protection against several chemical substances including vinyl chloride.
- Hooded, chemical resistant Tyvek® (Outer)
- Unhooded, chemical resistant white Tyvek® suit (Inner)
- Gloves - (Outer) - chemical resistant Neoprene
- Gloves - (Inner) - chemical resistant (latex).
- Boots - (Outer) - chemical resistant Neoprene with steel toes
- Hard hat
- Hearing protection (if necessary)
- Gloves, boots and respirator shall be taped to the outer Tyvek.

1.9.4 LEVEL D PROTECTION

The minimal level of protection that will be required of IT personnel and subcontractors at the site will be Level D. Based on data generated from previous site investigations, Level D should be sufficient for the work proposed herein. This type of protection requires the basic work uniform and should only be worn when operating away from any potential contact or exposure to any organic vapor contaminants. Level D protection will be used under conditions of support for operations where there are no indications for exposure.

The following equipment will be used for Level D protection:

- Coveralls (as appropriate)
- Boots/shoes - safety or chemical protection (latex booties) with steel toes
- Safety glasses or goggles
- Hard hat

- Work gloves (optional)

1.9.5 RESPIRATORY PROTECTIVE EQUIPMENT AND USE PROTOCOL

A comprehensive respiratory protection program has been established by IT Corporation. This program will be required in all locations where use of such equipment could lessen the potential for adverse health affects to any employee. The type of respiratory equipment will be continuously reevaluated based upon the current level of exposure. The only person who will be able to modify the level of respiratory protection is the regional OSH representative.

As part of the respiratory training program, each employee will have been instructed in the following elements:

- Nature of the respiratory hazard on the work site and the appraisal of what may happen if the respiratory protection is not utilized.

- Use and proper fitting of the respirator.

- Cleaning, disinfecting, inspection, maintenance, and storage of the respirator.

- Proper selection, capabilities, and their limitations.

The respiratory protection training program will be conducted, documented, and recorded by the Occupational Safety and Health representative.

Routinely used respiratory equipment will be inspected, cleaned, and disinfected daily to help assure proper hygienic practices. A safety equipment custodian shall maintain the respirators. An inspection of these breathing devices will include the following:

- Examination of the head straps for breaks, loss of elasticity, broken or malfunctioning buckles, and other attachments.

- Examination of the facepiece for excessive dirt, cracks, tears, distortion, holes, or inflexibility.

- Examination of the exhalation and inhalation valves for any foreign material, cracks, tears, distortion, in the valve. Additional checks will be made to inspect for proper insertion, defective valve covers, or improper installation.

- Examination of air purifying elements for incorrect cartridge, expired shelf-life of the cartridge, cracks or dents in the cartridge or cartridge holder.

- Examination of proper insertion of the cartridges into the facepiece and a check of the gaskets inside the cartridge holder.

- Examination of air cylinders for adequate air volume. Only grade D air will be utilized for breathing air.

When Level C protection is required, respirator cartridges will be changed daily. This requirement may be modified by the OSH representative depending upon the ambient exposure to the air contaminants.

The safety custodian will maintain the respiratory equipment and be knowledgeable in the cleaning and disinfection process. Each individual will scrub boots and gloves using detergent in warm water using a brush and then thoroughly rinsing with clear water. Finally, the respirators will be dried in a clean location after each day's use. If broken or malfunctioning parts are found during the cleaning process, these parts will be replaced or new respiratory equipment will be issued to the user.

The respiratory equipment will be stored in an area protected from any mechanical damage. These devices will also be stored in a location that provides protection against dust, heat, excessive moisture, or damage by chemical contact. The storage area for the respirators should be in a readily accessible location.

1.9.6 HEAT STRESS

1. If the project is conducted during the summer months, the total heat exposure to unacclimated workers will be controlled in order to protect these individuals from excessive levels of metabolic and environmental heat. The same conditions will apply to acclimatized workers, however, the level of heat standard must be higher for the acclimated workers. These work-rest regimens are specified in the ACGIH heat stress guidelines.

2. The heat stress of employees on-site will be monitored by the Wet Bulb

Globe Temperature Index (WBGT) technique. This method will require the use of a heat stress monitoring device, such as the Wibget Heat Stress Monitor (Reuter Stokes).

3. The WBGT will be compared to the TLV outlined in the ACGIH TLVs Manual, and a work-rest regimen will be established, as necessary, according to the WBGT obtained. Note that 2°C must be subtracted from the TLVs for heat stress listed to compensate for the wearing of impermeable protective clothing.

One or more of the following control measures can be used to help control heat stress:

- Provision of adequate liquids to replace lost body fluids. Employees must replace water and salt lost from sweating. Employees must be encouraged to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.

- Replacement fluids can be a 0.1 percent salt water solution, commercial mixes such as Gatorade® or Quick Kick®, or a combination of these with fresh water. Employees should be encouraged to salt their foods more heavily.

- Establishment of a work regimen that will provide adequate rest periods for cooling down. This may require additional shifts for workers.

- Cooling devices such as vortex tubes or cooling vests can be worn beneath protective garments.

- All breaks are to be taken in a cool rest area (77 degrees Fahrenheit is best).

- Employees shall remove impermeable protective garments during rest periods.

- All employees shall be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

During periods of high temperature and/or humidity, the site OSH representative will continually observe the workers for symptoms of heat stress especially in areas where protective clothing is being worn. If the body's physiological processes to maintain a normal body temperature fails, or are overburdened due to excessive heat exposure, a number of physical reactions can occur ranging from mild symptoms such as fatigue, irritability, anxiety, and decreases in mental concentration. Heat related problems are presented below:

> Heat Rash - This is caused by continual exposure to heat and humid air, and aggravated by chaffing clothes. Heat rash decreases a person's ability to tolerate heat as well as becoming an irritating nuisance.
>
> Heat Cramps - This is caused by profuse perspiration with inadequate water intake and chemical electrolyte imbalance. This results in muscle spasm and pain in the extremeties and abdomen.
>
> Heat Exhaustion - Increased stress on various organs to meet increasing demands to cool the body will result in signs and symptoms including shallow breathing; pale, cool, moist skin; profuse sweating; dizziness and lassitude.
>
> Heat Stroke - This is the most severe form of heat stress which must be treated immediately by cooling the body or death may result. Signs and symptoms include red, hot, dry skin; no perspiration; nausea; dizziness and confusion; strong, rapid pulse; and coma.

1.9.7 PHYSIOLOGICAL MONITORING

Whenever the ambient temperature exceeds 70°F (21°C), physiological monitoring will be performed when the operation requires workers to wear impermeable protective clothing. A baseline heart rate and oral temperature will be determined for each employee on site prior to any work activity.

After the initial work-rest regimen has been established by the on-site Health and Safety Coordinator, the worker's heart rate, and oral temperature will be monitored for each work cycle. If a worker's heart rate and oral temperature does not increase or increases slightly (10% or less for heart rate and 0.5% or less for the oral temperature), the work cycle can be increased by 20%.

The employee will be monitored closely during the next work cycle. If there still is no significant increase in either heart rate or oral temperature, the work period can increase by 10% with the same rest period. Increases in the work period can be made throughout the workshift, so long as there are no significant increases in the physiological monitoring indices.

The radial pulse of each worker will be determined during the initial 30 seconds of the employees's rest period. If the heart rate exceeds 110 beats per minute, the next work cycle shall be shortened by 30% while maintaining the same rest period. The work cycle shall continue to be shortened until the employee's heart rate falls below 110 beats per minute.

A disposable chemical thermometer shall be placed for a period of 3 minutes under the employees tongue. The oral temperature must be determined prior to consuming any liquid beverage. The work cycle will be shortened if the oral temperature exceeds 99.6^{o}F (37^{o}C). Should the oral temperature still exceed the criteria value, each subsequent work cycle shall be shortened by 30%. Under no circumstances will a worker be permitted to return to work when the Oral temperature exceeds 100.6^{o}F (38.1^{o}C).

1.10 DECONTAMINATION PROCEDURES

1.10.1 PERSONNEL DECONTAMINATION

A decontamination zone will be established at the perimeter of the exclusion zone. A step off area will be designated just outside the contamination zone. All employees entering from the exclusion zone will pass through the decontamination area to remove their respirators and/or protective clothing. The employees may then enter the break area after washing their face and hands. Employees must be screened by the "decon person" to ensure compliance with this procedure.

At the end of each work period (before eating, drinking smoking, or leaving the site) each person who has entered the contamination zone will decontaminate by passing through the contamination reduction line. Each of the following stations will be entered and used as appropriate.

- Equipment/Tool Drop Station
- Boot Wash - soiled reusable boots will be washed in a tub containing a detergent solution.
- Boot Rinse - personnel will step into a tub containing rinse water after washing boots.
- Glove Wash - intact reusable gloves will be wiped clean over a glove wash bucket containing detergent and water.
- Glove Rinse - washed gloves will be rinsed with water or wiped

with a water wet towel.

- Used coveralls and disposable boots and gloves will be dropped into a bag-lined garbage can.
- Spent disposable respirator or cartridges will be dropped into a bag-lined garbage can.
- Cleaned boots and gloves will be properly stored for reuse.
- Personnel may then exit the site through the access control point.

Before leaving the site, personnel will change work clothes in the contamination reduction corridor. Tyvek® coveralls will be placed into plastic bags for disposal at an approved facility.

Soiled boots, hard hats, respirators, and other equipment will be inspected daily, washed and scrubbed in a detergent/water solution. After cleaning, equipment will be rinsed thoroughly in water and allowed to dry on a clean surface.

All disposable work clothes, soiled gloves, and wash water will be collected and deposited into 55-gallon drums for disposal at a hazardous waste facility. After inspection and cleaning, other items left at the site will be properly stored in a designated area. Personnel will shower as soon as possible at the end of the work day.

If there is a rip or tear in the employee's protective clothing, that individual will remove the torn garment in the decontamination area and new protective clothing will be issued in order for the employee to return back to work. The same procedure will apply to defective respiratory equipment.

1.10.2 EQUIPMENT DECONTAMINATION

Any equipment used inside the exclusion zone will be considered contaminated and must be cleaned before leaving the work site. Decontamination of all large equipment including generators, backhoes, and other equipment will be performed on site. Verification that all equipment has been properly decontaminated will be the responsibility of the site project manager. All contaminated solvents generated from the cleaning operation will be collected and containerized for disposal. Appropriate personnel protective equipment will be specified for this particular procedure. Iso-octane, hexane, or other relatively common solvents may be used for decontamination of tools and equipment.

1.11 SITE SECURITY

A controlled access to the regulated area will be established. Only authorized personnel shall be permitted to enter the regulated area. No one will enter the exclusion or the contamination reduction zones without appropriate authorization. Drilling and sampling operations will be suspended until unauthorized individuals have left the site.

All persons entering the regulated area will be equipped with appropriate personnel protective devices.

All persons entering the regulated area must be familiar with and abide by the health and safety plan.

1.12 GENERAL WORK PRACTICES

- At least one copy of this procedure will be available at the work site.
- Contaminated protective clothing, equipment, and other materials will not be removed from the work site until all materials have been properly decontaminated.
- All containers or chemical products will be properly labeled with specific chemical names.
- Removal of contaminants from protective clothing or equipment by blowing, shaking, or any other means which disperses contaminants into the air will be prohibited.
- No food or beverages will be present or consumed in the contaminated areas.
- No tobacco products will be present or consumed in the contaminated area. Smoking will be permitted only in a specific designated location.
- All employees will be required to wash their face and hands prior to eating, drinking, or smoking.
- Use proper lifting techniques when handling bulky or heavy items.

- A charged fire hose or a sufficient quantity of fire extinguishers will be available at all times. Only spark resistant tools will be used where there are flammable or combustible materials.

- No waste materials will be taken from the site unless authorized and appropriately containerized and labeled.

- In the event of a possible spill and for decontamination of equipment, a six millimeter polyethylene tarp will be used under areas for decontamination.

1.13 EMERGENCY RESPONSE PLAN

Emergency response procedures will be developed for extraordinary conditions that may occur at the work site and will be covered during the Tailgate Safety meeting (Section 1.4). In addition, emergency situations reported throughout the NAPC facility are reported over the public address system along with any required excavation procedures.

1.13.1 GENERAL RESPONSE CONSIDERATIONS

Emergencies must be dealt with in a manner to minimize the health and safety risk to all site personnel. Work activities will be conducted in groups of at least two workers (buddy system) to provide continuous monitoring in the event of an emergency. Emergency signals will be developed to include a continuous 30-second blast of a horn. Other signals will be reviewed such as those developed for restricted air flow or breathing difficulty.

1.13.2 RESPONSIBILITIES

The site project manager will have the responsibility for directing the response activity in the event of an emergency. The responsibilities are described below:

- Assess the emergency situation and notify site security personnel.

- Determine the required response measures by informing the site supervisor.

- Notify the appropriate response teams of the specific action that will be taken upon request.

- Determine and coordinate the on-site personnel actions for the particular emergency situation.

- Contact and coordinate with any governmental or regulatory agency (i.e., New Jersey Department of Environmental Protection).
- Immediately complete the Supervisor Injury Report form upon occurrence of the accident or incident and list on the OSHA Occupational Injury/Illness form 200.

1.13.3 PUBLIC RESPONSE AGENGIES

Before the start of the construction and decontamination operations, the OSH representative will develop a list of public response agencies which may be contacted depending on the nature of the emergency. The list of contact agencies will include the name, address, and telephone number of the following:

* Police Department Ewing Township Police	(609) 882-1313
Base Facility	Ext. 5623
* Fire Department	Located on base, ext. 3333
* Ambulance Ewing Township Ewing, New Jersey	(609) 882-1313
Base Facility	Ext. 5618
* Hospital Mercer Medical Center 446 Bellevue Avenue Trenton, New Jersey	(609) 394-4009
* New Jersey Department of Environmental Protection 32 Hanover Street Trenton, New Jersey 08608	(609) 292-5560

In the event of an emergency, an outside agency may assume authority for the emergency response. Personnel will be instructed to assist the agency in charge. If a spill occurs releasing hazardous materials outside of the site perimeter, the response activities will be coordinated with those of recognized regulatory agencies. The appropriate contacts include, but are not limited to, the following:

* U.S. EPA II (Region II)	(212) 264-2525
* U.S. Coast Guard	(800) 424-8802
* NJDEP	(609) 292-5560